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GRIFFITHS jr. (J. T.), REITZ (H. J.) & OLSEN (R. W.). **Off-flavor produced in Florida Orange Juice after Application of new organic Insecticides.**—*Agric. Chem.* **5** no. 9 pp. 41–43, 99, 1 ref. Baltimore, Md., 1950.

The following is based on the authors' summary of this account of investigations carried out in Florida in 1948. BHC (benzene hexachloride), in the form of the technical material and a product containing 97–98 per cent. γ isomer, chlordan, toxaphene and parathion were each sprayed on three varieties of orange on different dates throughout the growing season, and mature fruits from the treated trees were sampled for possible changes of flavour in the fresh or canned juice. Statistical analysis of the results indicated that only technical BHC regularly affected the flavour. The BHC with the high content of γ isomer apparently affected it when applied with oil but not when applied as a wettable powder without oil, and chlordan, toxaphene and parathion had no effect when used at much higher dosages than those ordinarily used on *Citrus* in Florida. It is concluded that chlordan, toxaphene and parathion can be used without risk of affecting the flavour, but that when the fruit is present, technical BHC should not be applied and γ BHC should be used as a wettable powder and not combined with oil.

MAY (A. W. S.). **The Importance of the Calyx Spray in the Codling Moth Control Programme.**—*Qd agric. J.* **71** pt. 6 pp. 325–327. Brisbane, 1950.

Since the general adoption of DDT sprays for the control of *Cydia pomonella* (L.) on apple in Queensland [*cf. R.A.E.*, A **39** 34, etc.], spring moth populations have been low and, where DDT cover sprays have been applied at about three-weekly intervals, crop losses have been negligible. There has, however, been a general increase in the populations of *Eriosoma lanigerum* (Hsm.), *Tetranychus telarius* (L.) (*urticae* Koch) and *Bryobia praetiosa* Koch. During 1949–50, the importance of the calyx application when DDT cover sprays are applied was investigated in three orchards, two of which had been sprayed with DDT during the previous year. The percentages of fruits damaged at harvest on trees that received a routine schedule of DDT cover sprays preceded by a calyx application of 0·1 per cent. DDT, one of 3 lb. lead arsenate and 2·5 pints white oil in 100 gals. water or none were 1, 0·6 and 0·8, respectively. Observations in other orchards confirmed the conclusion that the calyx spray is of little value, but it is pointed out that its omission can be justified only where moth populations in spring are low.

WEST (T. F.), HARDY (J. E.) & FORD (J. H.). **Chemical Control of Insects.**—$7\frac{1}{2} \times 5\frac{1}{2}$ ins., xi+211 pp., 44 figs., refs. London, Chapman & Hall Ltd., 1951. Price 15*s*.

This book belongs to a series designed to fill the gap in scientific publications between the very elementary expositions and the specialist text-books. It comprises a survey of substances that are used in the control of arthropods, chiefly insects, of agricultural, medical or veterinary importance, and is based largely on literature published up to 1949 and includes chapters on nicotine, rotenone and related compounds, arsenicals, petroleum oils, coal-tar derivatives, pyrethrum, Thanite and the Lethane thiocyanates, chlorinated persistent insecticides, miscellaneous insecticides (notably hexaethyl tetraphosphate, parathion, azobenzene and sabadilla), fumigants, soil insecticides, and repellents and attractants. The information given for the various materials in general comprises methods of preparation, chemical and physical properties, chemical composition, mode of action, and methods of use, with a special reference to the more recent developments. Preliminary chapters contain accounts of the

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general principles of chemical and other methods of control and of the characters and habits of insects of which use can be made in such work. There is also a chapter on weed-killers.

DEICHMANN (W. B.), WITHERUP (S.), KITZMILLER (K. V.) & HEYROTH (F. F.). **The Toxicity of DDT. Part I. Experimental Observations... Part II. A Survey of the Literature.**—[2+] vi+233+16 pp., 15 pls., 33 tables (1 fldg.) [on 52 pp.], 257 refs., multigraph. Cincinnati, Ohio, Kettering Lab., Coll. Med., Univ. Cincinnati, 1950.

The first part of this work (pp. 1–71) is by Deichmann, Witherup and Kitzmiller, and comprises an account of investigations in Ohio on the toxicity of DDT to laboratory animals, chiefly rats and rabbits. It includes observations on immediate toxicity following application by various routes, characteristic symptoms, pathological changes induced in the tissues by DDT, the mechanism of its pharmacological action, and cumulative action following prolonged contact with the skin, inhalation of air contaminated by DDT, or repeated ingestion.

The second part (pp. 72–233) is by Heyroth and consists of a comprehensive review of the literature on the physical and chemical properties of DDT, its toxicity to mammals when administered by various routes, the symptoms and pathological changes produced by it in vertebrates, observations on the mechanism of its toxic action on insects and vertebrates, its toxicity to man following ingestion, cutaneous application and inhalation, the risks to man, beneficial insects and wild animals associated with its use, and the toxic action of closely related compounds to mammals.

CLAUSEN (C. P.). **The Time Factor in Biological Control.**—*J. econ. Ent.* **44** no. 1 pp. 1–9, 17 refs. Menasha, Wis., 1951.

The author records several instances of the introduction of effective parasites and predators against insects injurious to plants in the United States and elsewhere and shows that where full commercial control was eventually obtained, definite control was achieved in the vicinity of the colonisation points within three host generations in the great majority of cases and within three years in all [*cf. R.A.E.*, A **28** 246]. Effective natural enemies are defined as those that give consistent control, irrespective of influences that may cause the host population to vary widely, and full commercial control is defined as a degree of control beyond which other methods of control are not required or economically practicable. Parasites and predators that are only partially effective may be so because of a difference between host and natural enemy in response to environmental conditions, and no general estimate can be made of the time required for them to attain their maximum value, as this is governed by changing environmental conditions. Although ineffectiveness for three years constitutes definite evidence that a species will never consistently control its host, the attainment of full control in this time is no assurance that such effectiveness will be permanent.

It is concluded that the colonisation of an imported parasite or predator may be discontinued after three years if there is no evidence of establishment, provided that colonisation has been effected in each distinct climatic zone occupied by the host, that the colonies were adequate in size and number, that releases were synchronised with the time of abundance of the preferred host stages, that recovery collections were adequate and that no biological factor directly affecting continued reproduction was involved ; although establishment might be attained by further efforts, such a species would be of little real value.

Similarly, if a species becomes established, but there is no evidence of control within three years, it will probably never be attained, and colonisation aiming at direct control should be discontinued and the programme rearranged on a reduced basis, with greater allowance for natural spread to cover the infested area.

The examples of successful control given include that of *Promecotheca reichei* Baly on coconuts in Fiji by *Pleurotropis parvulus* Ferrière [*cf.* **25** 191], and in this connection mention is made of recent work that has led to the control of *Brontispa mariana* Spaeth [*cf.* **29** 331] on coconut in the Mariana Islands by *Tetrastichus brontispae* (Ferrière), which controls other species of *Brontispa* in Indonesia and other Pacific islands, attacks the larvae and pupae and was introduced from Java into Saipan and Rota early in 1948. Field control on Saipan was obtained in six months after the release of 25 colonies of the parasite numbering about 200 each. *T. brontispae* has a life-cycle of 16–20 days, whereas the host has 3–9 generations a year, depending on climate.

HASTINGS (E.) & PEPPER (J. H.). **Aerial and Ground Application of Insecticides for pre-season Control of Alfalfa Weevil.**—*J. econ. Ent.* **44** no. 1 pp. 9–13, 6 refs. Menasha, Wis., 1951.

Hypera variabilis (Hbst.) (*postica* (Gylh.)) is an important pest of lucerne in parts of the western United States and is increasing its range there. In addition to defoliation of the first crop by the larvae, retardation of the second crop, sometimes for three weeks or more, is an important factor in Montana, as there is no time for the seed to mature or for a third cutting to be produced. Difficulty has been experienced in wintering cattle and sheep on damaged lucerne hay, possibly owing to the reduction (found to be about 26 per cent.) in the carotene content.

Growers in Montana are unwilling to control the weevil by harvesting the newly infested first crop before it is fully grown, and control by other means is complicated by the overlapping of the developmental stages and the inaccessibility of the eggs and pupae. Since preliminary experiments showed that control of the overwintered adults before they oviposit prevents excessive destruction of the first crop of lucerne and retardation of the second [*cf. R.A.E.*, A **38** 255], field tests of this method were carried out in 1950. Emulsions prepared from concentrates were applied by ground machines at 8 U.S. gals. per acre and a pressure of about 50 lb. per sq. in. with the nozzles 18 ins. above the ground, and solutions in diesel fuel oil were applied at 2 U.S. gals. per acre from an aeroplane flying at a height of about 5 ft. Treatments were made on 10th–20th April, before oviposition was evident and when the new growth of lucerne was about 2 ins. high. BHC (benzene hexachloride), aldrin [1,2,3,4,10,10-hexachloro-1,4,4a,5,8,8a-hexahydro-1,4,5,8-diendomethanonaphthalene] and dieldrin [1,2,3,4,10,10-hexachloro-6,7-epoxy-1,4,4a,5,6,7,8,8a-octahydro-1,4,5,8-diendomethanonaphthalene] were applied by both methods and chlordan by aeroplane. Dieldrin was the most effective, giving more than 90 per cent. reduction to the numbers of adults and larvae in eight weeks when applied at 0·25 lb. per acre by either method, and chlordan next in value, giving effective reductions when applied at 2 lb. per acre [*cf. loc. cit.*]. Aldrin, tested at 0·19–0·77 lb. per acre, gave less control, and BHC at 0·23–0·5 lb. γ isomer per acre was relatively ineffective. In fields in which 90 per cent. control was obtained, there was no visible damage to the plants and the second growth was not retarded.

Widespread variations were noted in weevil populations between adjoining fields as well as in fields in different areas. No adult migrations were observed during the spring.

WILLE (J. E.). **Biological Control of certain Cotton Insects and the Application of new organic Insecticides in Perú.**—*J. econ. Ent.* **44** no. 1 pp. 13–18, 5 refs. Menasha, Wis., 1951.

Heliothis virescens (F.), which is the most important pest of cotton in the coastal valleys of central Peru, was controlled by natural enemies in the absence of insecticidal treatments in 1944–46 [*cf. R.A.E.*, A **33** 278]. In the season of 1946–47, however, some of the new chlorinated insecticides were applied, and it was found that a large increase of this and other pests of cotton occurred after treatment with DDT, BHC (benzene hexachloride) or toxaphene, because these materials killed the natural enemies without eliminating the pests.

In widespread tests in 1947–49, in which dusts of BHC (2 per cent. γ isomer), 5 per cent. DDT, a mixture containing 3 per cent. γ BHC, 5 per cent. DDT and 40 per cent. sulphur, 20 per cent. toxaphene with 40 per cent. sulphur, 5 per cent. chlordan, calcium arsenate, special calcium arsenate containing 2 per cent. γ BHC, calcium arsenate with sabadilla (1 : 1), and 20 per cent. sabadilla were applied 2–4 times per season at about 10–13 lb. per acre, all treatments resulted in economic loss, and untreated cotton was the healthiest and gave the highest yields. Counts of insect populations on the experimental plots showed that natural enemies controlled *H. virescens* more completely than any of the insecticides. Those observed, in order of efficacy and frequency, were *Paratriphleps laeviusculus* Champ., *Nabis punctipennis* Blanch., *Hyalochloria denticornis* Hsiao, *Parajalysus spinosus* Dist., *Orius tristicolor* (White), *Zelus* sp., two species of *Scymnus*, *Chrysopa californica* Coq., *Hippodamia convergens* (Guér.) and *Cycloneda sanguinea* (L.). *Paratriphleps* destroyed about 70 per cent. and the next four bugs about 20 per cent. of the eggs and young larvae on untreated plots ; all five were eliminated by organic insecticides in 24 hours, whereas calcium arsenate and sabadilla did not kill more than 40–45 per cent. DDT was the only one of the insecticides tested that effected much control of larvae of *H. virescens*, and it did not kill more than 75 per cent. of those in the first four instars. The variety of cotton (Tanguis) grown in Peru is very vigorous, and the cotton aphid [*Aphis gossypii* Glov.], the leafworm [*Alabama argillacea* (Hb.)] and *Anthonomus vestitus* Boh., as well as *H. virescens*, breed readily in its heavy growth. If it is irrigated too heavily in the middle of the summer, when the water supply is highest, females of *H. virescens* are attracted from distances of over 3 miles to oviposit on the juicy leaves. The plants are subject to continual attack for 7–8 months from October, and it would be necessary to apply DDT 20 or more times between early November and late April to obtain effective control.

As a result of these investigations, growers were recommended in 1949–50 to create favourable conditions for natural enemies by planting maize between the cotton plants, to use as little water as possible in irrigation and to delay insecticidal treatment for as long as possible. In valleys in which early, normal and late maize was planted between the rows of ratoon cotton in August and September and in newly planted cotton in September and October, eggs of *H. virescens* were deposited on the maize tassels rather than on the cotton plants in October. *Paratriphleps* increased rapidly on these eggs, and together with the other natural enemies, destroyed the eggs that were later deposited on cotton. Regulation of irrigation was necessary to prevent the deposition of such numbers that the natural enemies could not control them and was also desirable because the predators are apparently less active in a humid microclimate. Where heavy irrigation had been applied and large infestations had developed, the restriction of irrigation to a minimum led to rapid control without the application of insecticides. The average value of the total harvest was about 20 per cent. above normal in these valleys, whereas it was below normal in those in which 15–20 applications of organic insecticides were made.

MUNDINGER (F. G.). **The Apple Flea Weevil.**—*J. econ. Ent.* **44** no. 1 pp. 28–33, 6 figs., 3 refs. Menasha, Wis., 1951.

In New York State, infestation of apple by *Rhynchaenus pallicornis* (Say) occurs at Syracuse and Nassau, and investigations on its control were begun as a result of an outbreak at Syracuse in 1937. The adult weevils overwinter in sod or under débris in or near the orchards, migrate to the trees with the onset of warm weather, usually in April, and mate and oviposit soon after. They feed on the buds or lower surfaces of the leaves and survive in cages for up to 48 days after leaving hibernation. One or more eggs are laid in a single leaf, usually in the midrib on the lower surface, but sometimes in the smaller veins or in the leaf tissue. The larva mines between the leaf surfaces and pupates in a chamber at the end of the burrow ; the larval and pupal stages lasted a minimum of 18 days. The adults of the new generation feed on the foliage until July or August, and then enter hibernation, most of them before September.

None of the spray treatments tested against the overwintered adults in May 1937 gave good control, but fluorine compounds were more effective than lead arsenate [*cf. R.A.E.*, A **24** 714]. In 1938, two applications of 5 lb. 90 per cent. sodium fluoaluminate or 5 lb. of a mixture containing 72 per cent. barium fluosilicate and 8 per cent. sodium fluoaluminate, each with 3 oz. sulphite lye (goulac), per 100 U.S. gals. in April gave 87·4 and 84·8 per cent. control as compared with no treatment, and were the best materials tested. In 1940 and 1941, dusts of pyrethrum extract, cubé and nicotine were applied, chiefly in midsummer, when adults of the new generation were plentiful. The dusts caused large numbers to drop from the trees, and pyrethrum (0·2 per cent. pyrethrins) and cubé (1–1·5 per cent. rotenone) gave over 90 per cent. kill in 29 hours, but 4 per cent. nicotine caused only temporary disablement. Caged weevils dusted with the pyrethrum or cubé died within 48 hours, but untreated ones on dusted foliage were not apparently affected. In 1946, applications on 19th and 30th April of 1 or 2 lb. 50 per cent. DDT or 5 lb. 90 per cent. sodium fluoaluminate per 100 U.S. gals. gave 97·6, 99·8 and 92·7 per cent. control, and a single application on 30th April of the first and last of these gave 87·3 and 81·3 per cent. In 1948, single applications on 8th July of 0·75 lb. 25 per cent. parathion, 2 lb. 50 per cent. DDT, 2 lb. benzene-hexachloride powder (6 per cent. γ isomer) and 5 lb. ground derris root per 100 U.S. gals. gave 98·6, 97·5, 96·6 and 3·5 per cent. control.

It is concluded that 1 lb. actual DDT per 100 U.S. gals. spray was the most effective treatment tested and that sprays were most effective when applied in early spring against the overwintered weevils. Two applications were better than one, but one may be sufficient in seasons of rapid flower-bud development. The first application should be made at the pre-pink stage and the second a week later, and the undersides of the leaves should be thoroughly covered.

DOUTT (R. L.). **Biological Control of Mealybugs infesting commercial Greenhouse Gardenias.**—*J. econ. Ent.* **44** no. 1 pp. 37–40, 2 graphs, 3 refs. Menasha, Wis., 1951.

In 1950, the use of predators and parasites for control of *Pseudococcus citri* (Risso) on greenhouse gardenias and the compatibility of this method with normal greenhouse cultural practices were investigated in California. Infestation was uniform and heavy in all the three commercial houses used, and all already contained *Cryptolaemus montrouzieri* Muls. and *Leptomastidea abnormis* Gir., though neither gave consistent control. *C. montrouzieri* was ineffective because the temperature fell below its threshold of activity (70°F.) for long periods ; the action of *L. abnormis* at low temperatures was not determined.

Two of the greenhouses received no insecticide treatment against the mealybug but were treated against mites by periodical applications of TEPP (tetraethyl pyrophosphate) to the steam pipes ; this was shown not to affect the beneficial insects. In the first of them, batches of natural enemies including the predators, *Chrysopa californica* Coq., *Scymnus binaevatus* Muls., *S. quadrivittatus* Muls., *Exochomus flavipes* (Thnb.), *Chilocorus angolensis* Crotch and *Hyperaspis lateralis* Muls., and the parasites, *Anagyrus kivuensis* Comp. and *Tropidophryne melvillei* Comp., were introduced periodically from 1st April until 15th June. *Chrysopa*, *Exochomus* and *Anagyrus* soon became established, and they kept infestation by the mealybug at a very low level (less than 1 per cent. of the terminals infested) from the end of June until October. The other five species disappeared. It had been intended to use the second greenhouse for observations of the effectiveness of *Cryptolaemus* and *Leptomastidea* alone ; they began to reduce the mealybug with the advent of warm weather, but it was found in August that *Exochomus* had been accidentally introduced. The three species together quickly controlled the mealybug so that by October infestation was about as low as in the first greenhouse. In the third, an aerosol application of tetraethyl dithiopyrophosphate on 12th July reduced infestation considerably, and repeated applications until October kept it low, though not so low as in the first house. A light infestation by *Saissetia coffeae* (Wlk.) (*hemisphaerica* (Targ.)) which was parasitised by *Metaphycus helvolus* (Comp.) and *Encyrtus infelix* (Embleton), was present in all three greenhouses at the beginning of the test. It increased enormously after the aerosol applications and by 8th September was infesting 83 per cent. of the terminals in the third house, as compared with only 1·5 per cent. in the first, and had to be controlled with hydrocyanic acid gas. The aerosol was, however, more effective against mites than the TEPP used against them in the first two houses.

It is concluded that the practical use of natural enemies against mealybugs in greenhouses appears to depend primarily on the use of effective acaricides that are innocuous to beneficial insects. These exist, but not as aerosols, which are preferred by most growers.

BOTTGER (G. T.). **Sugars and Protein in the Corn Plant as related to Nutrition of the European Corn Borer.**—*J. econ. Ent.* **44** no. 1 pp. 40–44, 3 refs. Menasha, Wis., 1951.

The following is based on the author's summary. An experiment was carried out in the laboratory in Ohio to determine the relation of the sugar and protein contents of different parts of growing maize plants to the nutrition of *Pyrausta nubilalis* (Hb.) as measured by the survival and weight of the larvae. Samples of leaves, internodes and kernels removed from the cob were frozen, for safe storage, immediately after harvesting, and later fed to the larvae, which were weighed when they were ten days old and then at intervals of four days until they were 30 days old.

Wide differences were apparent in the chemical composition of the different plant parts and in the average survival and growth rates of the larvae reared on them. The leaves, kernels and internodes of sweet maize contained 1·1, 2·7 and 5·4 per cent. reducing sugar and 2·8, 3·0 and 0·8 per cent. protein in terms of green weight. High survival but low weights of larvae resulted when they were restricted to leaf tissue for food, whereas feeding exclusively on internode tissue resulted in low survival with relatively high weights. The weights of larvae reared on the kernels varied more consistently with differences in reducing-sugar content than with differences in protein, and high weights tended to be associated with high survival. There was some indication that the larvae did not respond favourably to increases in the percentage of invert sugars in their

diet and that these sugars had a detrimental effect on them where there was a deficiency of reducing sugars.

Stansbury (R. E.) & Dahm (P. A.). **The Effect of Alfalfa Dehydration upon Residues of Aldrin, Chlordane, Parathion, and Toxaphene.**—*J. econ. Ent.* **44** no. 1 pp. 45–51, 4 graphs, 17 refs. Menasha, Wis., 1951.

The following is based on the authors' summary. A biological assay method was used to determine the effect of commercial dehydration of lucerne, as carried out in Kansas, on residues left by sprays containing emulsion concentrates of aldrin [1,2,3,4,10,10-hexachloro-1,4,4a,5,8,8a-hexahydro-1,4,5,8-diendomethanonaphthalene], chlordan and toxaphene and a wettable-powder suspension of parathion. The lucerne was sprayed in the field and immediately cut and hauled to the dehydrator, where samples of the chopped lucerne were taken. The remainder was then subjected to the dehydration process, and further samples were collected. The samples were extracted with benzene, and adults of *Musca domestica* L. were caged with residues of the decolorised extracts for one hour. The results of over 400 assays showed that residues of the four insecticides were reduced considerably by the dehydration process. The rates of application of insecticide per acre, the average residues in parts per million, and the average percentages by which dehydration reduced these were, respectively, 0·5 lb., 19 and 69 for aldrin, 1·5 lb., 100 and 81 for chlordan, 2·25 lb., 81 and 66 for toxaphene, and 0·5 lb., 18 and 84 for parathion. All residue values were based on the wet weight of the lucerne.

Wolcott (G. N.). **Control of the Soil-inhabiting Grubs of Puerto Rico.**—*J. econ. Ent.* **44** no. 1 pp. 58–60, 2 refs. Menasha, Wis., 1951.

The roots of various crops in Porto Rico are attacked by the larvae of *Cnemarachis* (*Phyllophaga*) *portoricensis* (Smyth) and *C.* (*P.*) *vandinei* (Smyth) (white grubs) and by those of the weevil, *Diaprepes abbreviatus* (L.), which move freely in the soil in the first three instars [*cf. R.A.E.*, A **25** 570] and again during the so-called diapause before pupation [*cf.* **23** 113] and are then exposed to the action of soil insecticides. In the laboratory experiments described, *Diaprepes* larvae were exposed to soil with which the insecticides had been mixed for testing against the white grubs, the concentrations being expressed as lb. per acre. In tests against third-instar white grubs, aldrin [1,2,3,4,10,10-hexachloro-1,4,4a,5,8,8a-hexahydro-1,4,5,8-diendomethanonaphthalene], lindane [at least 99 per cent. γ BHC (benzene hexachloride)], DDD (dichlorodiphenyldichloroethane) and DDT had all been effective, and aldrin and lindane at 2 lb. were effective even after being mixed in the soil for a year, but all the materials were ineffective against large or fully grown larvae of *Diaprepes*. Attention was therefore directed to the very young larvae. The adults oviposit in every month of the year, and reinfestation of the soil continues at a fairly constant rate, since in May and June, when oviposition is at a maximum, the eggs are heavily parasitised by *Tetrastichus haitiensis* Gah. Growers, however, are unwilling to apply insecticides until plant injury has become noticeable, and materials that would remain toxic to the newly hatched larvae in the soil for several years are therefore the most likely to prevent injury. In small-scale tests between November 1949 and January 1950, *Diaprepes* larvae that had hatched within the previous 24 hours were put on treated soil in which seeds were planted and examined about once a week until they died or reached the fourth instar. Aldrin at 0·5 lb. gave complete kill in 27 days, and aldrin at 1 lb. and DDD at 10 lb. within 41 days. Larvae had reached the fourth instar by the 33rd day in soil mixed with γ BHC at 1 lb. or chlordan at 1–2 lb., by the 41st day in soil containing γ BHC at 2 lb., DDT at 10 lb. or no toxicant, and after 47 days in

soil containing methoxy-DDT (methoxychlor), zinc dimethyldithiocarbamate or *Ryania* at 10 lb. In similar tests in May 1950, all larvae died in about two weeks in soil containing aldrin at 0·5–5 lb. and within 16 and 20 days in soil containing chlordan at 10 and 5 lb., respectively. Some larvae reached the fourth instar in 20 and 32 days in soil containing chlordan at 1 and 2 lb., and some were still alive and in the second instar after 19 days in soil containing DDT at 20 and 25 lb., but were dead by the 29th day. Larvae reached the fourth instar within 24, 31 and 38 days in soil containing γ BHC at 1, 5 and 10 lb., respectively.

MITCHENER (A. V.). **Aldrin and Dieldrin compared as Grasshopper Poisons.**—*J. econ. Ent.* **44** no. 1 pp. 66–70, 1 ref. Menasha, Wis., 1951.

Camnula pellucida (Scudd.), *Melanoplus bivittatus* (Say) and *M. mexicanus mexicanus* (Sauss.) are the most injurious grasshoppers in Manitoba, and cage experiments were carried out in 1950 on the efficiency of aldrin [1,2,3,4,10,10-hexachloro-1,4,4a,5,8,8a-hexahydro-1,4,5,8-diendomethanonaphthalene] and dieldrin [1,2,3,4,10,10-hexachloro-6,7-epoxy-1,4,4a,5,6,7,8,8a-octahydro-1,4,5,8-diendomethanonaphthalene] against each and the length of time for which the insecticides remained toxic on seedling oats and cabbage leaves.

In tests against field-collected nymphs of *C. pellucida*, young oat plants were sprayed thoroughly on 12th July with 232·6 cc. 23 per cent. aldrin emulsifiable concentrate or 236·6 cc. 24 per cent. dieldrin concentrate per 5 Imp. gals. water and fed to caged nymphs 1, 3, 7 or 12 days later. As compared with no treatment, aldrin gave satisfactory control (82·6 per cent.) on the first day, but not subsequently, while dieldrin proved effective on all occasions (92·8–100 per cent.). In tests against field-collected adults of the three species, cabbage plants growing in the field were sprayed thoroughly on 23rd August with 4 oz. aldrin or 2 oz. dieldrin per 40 gals. water, with a wetting agent, and fed to the grasshoppers 1–29 days later. All species fed readily at all times. Dieldrin gave good control of adults of *C. pellucida*, *M. bivittatus* and *M. mexicanus* for 15, 13 and 9 days, respectively, and aldrin for five days in each case. Counts of the numbers killed 24 and 48 hours after feeding on sprayed leaves showed that dieldrin acted more quickly than aldrin on all three species and that *C. pellucida* succumbed to both compounds more quickly than the other species.

PLANK (H. K.) & HAGEMAN (R. H.). **Starch and other Carbohydrates in Relation to Powder-post Beetle Infestation in freshly harvested Bamboo.**—*J. econ. Ent.* **44** no. 1 pp. 73–75, 2 graphs, 2 refs. Menasha, Wis., 1951.

The relation between the content of starch and other carbohydrates in freshly harvested bamboo, the corresponding iodine spot test reaction [*cf. R.A.E.*, A **36** 55] and susceptibility to infestation by *Dinoderus minutus* (F.) was investigated in Porto Rico. Culms 1–5 years old were harvested from well-established clumps of bamboos of five species, and the next day an internode was cut from the base, middle and top of each culm and sawn into 0·75 in. sample rings, which were tested with iodine, exposed to infestation by adults of *Dinoderus* or analysed for starch, reducing sugars and insoluble carbohydrates hydrolysable by hydrochloric acid.

The results showed a strong positive correlation between the results of the iodine test and analyses for starch, starch with reducing sugars, and hydrolysable carbohydrates, and also between the results of each of these tests and insect attack. It was evident that reducing sugars were an unimportant factor in influencing infestation. Hydrolysable carbohydrate content (starch with pentosans and some celluloses) was a good indicator of susceptibility to beetle

attack, but less accurate than starch alone, and it was apparent that severity of attack was governed directly by the starch content of the bamboo at the time of exposure to infestation. Within certain limits, intensity of reaction to the iodine spot test was a reliable indication of starch concentration and the intensity of subsequent infestation.

WAKELAND (C.). **Changing Problems and Procedures in Grasshopper and Mormon Cricket Control.**—*J. econ. Ent.* **44** no. 1 pp. 76–82. Menasha, Wis., 1951.

The author discusses the changes that take place in infestations of grasshoppers and the mormon cricket [*Anabrus simplex* Hald.] in the United States and the development of methods of controlling them. He gives illustrations of the ways in which grasshopper populations change with changes in cropping practices over extensive areas and how the predominance of different species is affected by natural factors and by control practices, which may permit some species to increase while reducing others, and describes the use of surveys of grasshopper adults on both cultivated and range land to show where economic infestations may be expected and of egg surveys to confirm population trends, and the effect of such control measures as have been used. Surveys for *Anabrus* are much less detailed ; areas known to harbour populations of adults are mapped in the autumn, and no egg survey is necessary, as control measures are not applied until the nymphs have begun to band and migrate.

Control measures against grasshoppers have changed considerably since they were first introduced. Little organised control was possible until 1885, when moist bran baits were developed. These were used almost exclusively until 1946, after which sprays and dusts of BHC (benzene hexachloride), chlordan and toxaphene were employed with satisfactory results. More recently, other new insecticides have shown promise, and aldrin [1,2,3,4,10,10-hexachloro-1,4,-4a,5,8,8a-hexahydro-1,4,5,8-diendomethanonaphthalene] applied to vegetation harbouring grasshoppers at the rate of 2 oz. per acre in 1 U.S. gal. stove oil or kerosene by means of an aeroplane flying not more than 20 ft. above ground has given economic control of all species, usually in one application. In baits, lead arsenate was superseded by sodium fluosilicate, and this by the new insecticides. A dry bait, consisting of bran lightly impregnated with an oil solution of chlordan, toxaphene or aldrin, has been developed for application by aeroplane, and has made the control of grasshoppers on extensive areas of range land feasible. If grasshoppers on range land are ignored, large outbreaks may develop and involve both range and cultivated land, and surveys for incipient infestations, which can be destroyed at a relatively low cost, are desirable. Further research is needed on the causes of outbreaks.

Experience has shown that when BHC, chlordan, toxaphene or aldrin is used with proper precautions, grasshoppers are controlled without apparent injury to man or livestock or serious loss of bees. The effect of these insecticides on parasites and predators of grasshoppers in farm areas is unimportant, as these are effective only locally and sprayed areas comprise only a fraction of the crop area. Serious disturbance of the balance between the host and its insect enemies is more likely to occur when whole areas of range land are sprayed, but if natural enemies are affording some control and their emergence and breeding periods are ascertained, applications can probably be timed so as not to affect them.

Anabrus simplex was controlled with sodium-arsenite dust applied by hand gun until 1937 and by power dusters during the next few years. Dusting was accompanied by the use of trench and metal barriers, traps and barriers of oil on water. Sodium-fluosilicate baits were introduced in 1942, and baits of bran

impregnated with oil and insecticide and applied with power ground machines or by aeroplane later. Bait stopped migrating bands better than barriers, and the prevention of outbreaks is now carried out cheaply by directing control against small concentrations in known infested areas and destroying so many that they have no opportunity to band, migrate and form larger bands that grow to outbreak proportions.

A. simplex was observed in increasing numbers in several states in 1950 and showed a banding and migrating tendency not observed for several years. The author considers that unless the small bands are controlled in 1951, a major outbreak may develop.

ATKINS jr. (E. L.). **Spray Tests on *Citrus* to control Fruit Tree Leaf Roller.**— *J. econ. Ent.* **44** no. 1 pp. 82–87, 4 refs. Menasha, Wis., 1951.

The following is partly based on the author's summary. *Tortrix* (*Archips*) *argyrospila* (Wlk.) infested more than 2,700 acres of navel and Valencia oranges in adjacent parts of San Bernardino and Los Angeles counties, California, during April and May 1950. Injury consisted primarily of rolling, webbing and feeding on the shoots of the spring flush of growth, but extensive damage was also caused by the feeding of the larvae on the blossoms, and the newly set fruit was attacked and destroyed in many groves. In two groves, considerable damage was done to mature navel oranges on the trees, and a large proportion of the navel oranges from one moderately infested grove was damaged in the packing house, where the fruit had been stored for three days before washing and grading. The eggs of this Tortricid are laid in late spring or summer and do not hatch until the following spring. In 1950, hatching occurred in March and April, the larval and pupal stages averaged about 4–5 weeks and 10–11 days, respectively, and the adults were present from 11th May to 28th July and had begun to oviposit by 15th May.

DDT gave satisfactory control of the larvae when applied commercially or in field trials at 6 lb. 50 per cent. wettable powder in 300–500 U.S. gals. water per acre with a Speedsprayer [*cf. R.A.E.*, A **34** 195], boom-sprayer or spray-duster [*cf.* **37** 378] or at 5 lb. in 150 U.S. gals. with a spray-duster operating with a pressure of 450 lb. per sq. in. at the nozzles.

Other insecticides were applied in field trials in 500 U.S. gals. water per acre by boom-sprayer or Speedsprayer or in 300 U.S. gals. by spray-duster. In tests of wettable powders (in which amounts shown are per acre), satisfactory control was given by 50 per cent. DDD (TDE [dichlorodiphenyldichloroethane]) at 6–12 lb. in the boom-sprayer, 6–8 lb. in the Speedsprayer and 6 lb. in the spray-duster, and by EPN-300 (27 per cent. ethyl p-nitrophenyl thionobenzenephosphonate) or 25 per cent. parathion at 3–6 lb. in the boom-sprayer and 3–4 lb. in the Speedsprayer. Less satisfactory results were obtained with 50 per cent. methoxy-DDT (methoxychlor) at 8–12 lb. in the boom-sprayer and 6–8 lb. in the Speedsprayer, 25 per cent. aldrin [1,2,3,4,10,10-hexachloro-1,4,4a,5,8,8a-hexahydro-1,4,5,8-diendomethanonaphthalene] at 3 or 6 lb. in the spray-duster, and 25 per cent. dieldrin [1,2,3,4,10,10-hexachloro-6,7-epoxy-1,4,4a,5,6,7,8,8a-octahydro-1,4,5,8-diendomethanonaphthalene] at 3 lb. in the Speedsprayer or spray-duster. *Ryania* at 30 lb. in the boom-sprayer and 15 lb. in the Speedsprayer had little effect. The spray-duster was also used to apply aldrin and dieldrin in emulsions giving 0·75–1·5 and 0·75 lb. actual toxicant per acre, respectively, and both proved about as effective as they were in wettable powders applying the same amounts.

Of the equipment used, the Speedsprayer afforded the most uniform tree coverage, followed closely by the boom-sprayer and the spray-duster.

Stitt (L. L.). **Control of *Hylemya brassicae* in Radishes.**—*J. econ. Ent.* **44** no. 1 pp. 87–89, 4 refs. Menasha, Wis., 1951.

Hylemyia brassicae (Bch.) damages 10–80 per cent. of the radish crop in western Washington, and investigations on its control with single applications of some of the newer insecticides as dusts at low dosages were carried out in 1949–50. In 1949, the dusts were broadcast and incorporated into the upper ⅛–¼-in. of soil by raking on the day before sowing, applied to the soil in the furrows at the rate of about 11 cc. per 10 ft. of row with a salt shaker at sowing, or shaken along the line of the furrow in a band 2 ins. wide at the same rate three days after sowing. In 1950, they were applied in the furrow with the seed at the rate of about 15 cc. per 10 ft. of row. About 2½–6 times as much insecticide was applied per acre by the broadcast method as by the other two.

Broadcast and band applications of 1 per cent. lindane [at least 99 per cent. γ benzene hexachloride] at 2·5 and 0·9 lb. lindane per acre, respectively, were ineffective, but furrow applications of 0·9 lb. in rows 12 or 18 ins. apart gave excellent control. Dusts containing 2·5 per cent. aldrin [1,2,3,4,10,10-hexachloro-1,4,4a,5,8,8a-hexahydro-1,4,5,8-diendomethanonaphthalene] or dieldrin [1,2,3,4,10,10-hexachloro-6,7-epoxy-1,4,4a,5,6,7,8,8a-octahydro-1,4,5,8-diendomethanonaphthalene], broadcast at 12·5 lb. toxicant per acre or applied by the other methods at 2 and 2·1 lb. toxicant per acre when the rows were 12 ins. apart and 2·4 and 5·2 lb. when they were 18 ins. apart, chlordan broadcast at 25 lb. per acre or applied at 4·9 lb. per acre in 12-in. rows and 5·7 lb. in 18-in. rows in a 5 per cent. dust, and parathion broadcast at 5 lb. per acre or applied at 1 lb. in 12-in. rows or 0·4 lb. in 18-in. rows in a 1 per cent. dust all gave highly significant reductions in infestation, as compared with no treatment. Lindane affected flavour in 1950, particularly in the radishes sown in late May and June, but no other material caused tainting. Abnormal growth was observed in the lindane plots, in which 4–8 per cent. of the radishes were affected, but was rare in the others. In the greenhouse, lindane and chlordan caused some stunting of the plants when applied in the furrow at high rates, but aldrin, dieldrin and parathion did not.

Hill (R. E.) & Muma (M. H.). **Chlorinated Chemical Control of the Sandhill Cutworm.**—*J. econ. Ent.* **44** no. 1 pp. 90–92. Menasha, Wis., 1951.

Severe injury by *Euxoa detersa* (Wlk.) to maize growing on light sandy soils occurs nearly every year in north-central Nebraska, and since chlorinated insecticides tested for another purpose in Pierce County in 1948 gave excellent control of this cutworm, investigations were continued in 1949 and 1950.

In 1948, DDT and BHC (benzene hexachloride) in suspension and chlordan and toxaphene in emulsion were applied at 5 lb., 1 lb. γ isomer, 1 lb. and 1 lb., respectively, per acre in 100 U.S. gals. water, either all over the ground on 4th May, before the maize was sown, or to the bases of the plants on 28th May, at the time of the first cultivation. All treatments applied before sowing gave significant protection until 28th May, and all but toxaphene until 3rd August. DDT was significantly better than any other treatment. Application at the time of cultivation was too late to be of value, and only DDT reduced the damage to an extent approaching significance. In 1949, observations on plants treated with 0·5–2 lb. DDT per acre showed that a rate of 1 lb. was effective. Timing of applications was investigated in 1950 by applying DDT at 1 lb. per acre and toxaphene at 2 lb. per acre in emulsion sprays at the rate of 12 U.S. gals. per acre over the entire soil surface of two series of plots. In the first, applications were made on 18th May, before planting, on 24th May, after planting, or on 3rd June, at the time of the first cultivation. Only plots treated with DDT on 24th May showed a significantly bigger stand than untreated ones

on 3rd June. Cutworms were still active between 3rd June and 7th July, but both DDT and toxaphene applied on 24th May caused significant reductions in loss of stand. Treatment before sowing or after damage had occurred was less effective. In the second series, in which corresponding applications were made on 18th and 19th May and 3rd June, similar trends were observed, but the differences were not significant. In general, DDT was more effective than toxaphene, and the results indicated that a higher dosage of DDT before sowing might have been effective.

It is concluded that DDT was the most effective of the insecticides tested, that comparable results may be expected with emulsion or wettable-powder sprays applied in large or small quantities per acre and that treatment soon after sowing is more effective than treatment before sowing or after the plants appear. The results were confirmed by observations in commercial fields.

TURNER (N.). **Synergism between Nicotine and Pyrethrum.**—*J. econ. Ent.* **44** no. 1 pp. 106–108, 1 ref. Menasha, Wis., 1951.

In tests in which various amounts of nicotine and pyrethrum were injected into adult milkweed bugs [*Oncopeltus fasciatus* (Dall.)], alone and together, the results of which are shown in detail in tables, the mixtures caused far higher mortality than would have been expected from the toxicity of either component alone. When pyrethrum was injected 24 hours after the nicotine, the mortality was approximately the same as that following joint application. Total mortality tended to decline as the time between injections was increased. When nicotine was injected 24 hours after pyrethrum, the mortality was lower than that obtained with the two materials applied together.

These preliminary tests indicate that nicotine and pyrethrum are synergistic when injected into the bugs and that nicotine conditions them for a higher mortality from pyrethrum.

MARCOVITCH (S.). **Sodium Fluosilicate as an Activator for certain Organic Insecticides and Herbicides.**—*J. econ. Ent.* **44** no. 1 pp. 108–109. Menasha, Wis., 1951.

Since solutions of substituted phenols have proved more toxic as insecticides or herbicides when acidified with oxalic acid, ammonium sulphate or sodium bisulphate, the effect was tested of adding sodium fluosilicate, which is cheap, readily available and easy to handle, to aqueous solutions of the triethanolamine salt of dinitro-o-sec.-butylphenol, sodium pentachlorophenate, sodium dinitro-o-cresylate and sodium trichloroacetate. The butylphenate in water at 1 : 1,000 gave 80 per cent. kill of larvae of *Culex fatigans* Wied. (*quinquefasciatus* auct.) in 24 hours without sodium fluosilicate and 100 per cent. in 13 minutes when the fluosilicate was added at the rate of 1 : 4,000, and equally striking increases in toxicity were produced when it was added to sodium pentachlorophenate, sodium trichloroacetate and sodium dinitro-o-cresylate. The fluosilicate alone at 1 : 4,000 gave 80 per cent. kill in six hours. A 1 : 4,000 solution of dinitro-o-cresol in distilled water with a pH of 6·8 gave complete mortality in 30 minutes, whereas the same concentration in tap water with a pH of 7·4 had no effect in six days.

Harlequin bugs [*Murgantia histrionica* (Hahn)] were unaffected after immersion for three minutes in sodium pentachlorophenate in water (1 : 3,000) but died three minutes after immersion in the same solution acidified with sodium fluosilicate. A solution of sodium dinitro-o-cresylate (1 : 400) gave 40 per cent. control of the euonymus scale [*Unaspis euonymi* (Comst.)], heavily encrusted on stems and leaves, when used alone, 85 per cent. when used with sodium

fluosilicate, and 100 per cent. when used with sodium fluosilicate and 0·25–0·5 per cent. sodium alkyl aryl sulphonate as a wetting agent. Similar results were obtained in tests against weeds.

FENTON (F. A.) & DAHMS (R. G.). **The 1950 Greenbug Outbreak in Oklahoma.** —*J. econ. Ent.* **44** no. 1 pp. 111–112. Menasha, Wis., 1951.

The author describes a severe outbreak of greenbugs [*Toxoptera graminum* (Rond.)] that occurred on wheat in Oklahoma in the spring of 1950, the weather conditions that preceded it and the organisation of control. Parathion and a commercial preparation containing both parathion and its dimethyl analogue were found to give control when applied in emulsion form by ground machines or aeroplanes. Parathion wettable powder was too abrasive to gear pumps for effective use.

The preceding summer had been cool, with low but well distributed rainfall, precipitation was high in September and dry conditions prevailed from October to April. The Aphid was uniformly distributed in the wheat fields in November, and the outbreak reached its peak in March and April, when the weather was too cool for parasite activity, but not for rapid development of the Aphids, and drought retarded the growth of the plants. The wheat was completely destroyed over thousands of acres, and the average yield dropped from 13·8 to 8·5 bushels per acre, but on 653,936 acres treated with parathion, the average improvement in yield was conservatively estimated at 4 bushels per acre, the value of this increase being about four times the cost of the treatment. The average yield of oats dropped from 19·8 to 17·5 bushels per acre, and that of barley from 16·2 to 11.

FISHER (E. H.) & BERGER (K. C.). **Alfalfa Seed Production as influenced by Insecticide and Fertilizer Application.**—*J. econ. Ent.* **44** no. 1 pp. 113–114. Menasha, Wis., 1951.

Symptoms of fertiliser deficiency and damage by insects have been observed on lucerne in many fields in Wisconsin and are sometimes similar, with the result that there is difficulty in determining the relative importance of deficient soil fertility, especially a low boron level, and insects in damaging lucerne. During 19th–26th April 1947, top dressings of 400 lb. fertiliser (0-20-20) per acre, alone or with 40 lb. borax, were applied to strips of established lucerne alternating with untreated strips on soil of three different types. Bands crossing these were left undusted or dusted on 3rd–9th August with 5 per cent. DDT at about 40 lb. per acre during a late flower-bud stage of the second crop, which was to be left for seed. The dusts were applied by aeroplane or with a hand duster. Among the most important insects attacking the crop were *Lygus oblineatus* (Say), *Adelphocoris lineolatus* (Goeze), *A. rapidus* (Say) and *Empoasca fabae* (Harr.). The crop was harvested in September. For soil fertility it is necessary that the lime, phosphate and potassium level, as well as the available boron content, should be high, but even high fertility levels did not result in seed production when large numbers of insects were present. Yields were consistently increased by the application of either insecticide or boron, but the maximum yields were not obtained unless both were used. Seed yields from the combined treatments were 40–77 per cent. higher than those from any others.

GAINES (J. C.) & HANNA (R. L.). **Grasshopper Control.**—*J. econ. Ent.* **44** no. 1 pp. 116–117, 1 graph, 2 refs. Menasha, Wis., 1951.

The results are given of laboratory and field tests carried out near College Station, Texas, during the spring of 1950 to compare several new organic

compounds with the materials commonly used for the control of *Melanoplus differentialis* (Thos.). In laboratory tests, in which various doses of each material in emulsion sprays were applied as contact insecticides to nymphs [*cf. R.A.E.*, A **38** 367] and the dosage-mortality curves plotted, aldrin [1,2,3,4,10,10 - hexachloro - 1,4,4a,5,8,8a - hexahydro - 1,4,5,8 - diendomethano - naphthalene] and dieldrin [1,2,3,4,10,10-hexachloro-6,7-epoxy-1,4,4a,5,6,7,8,8a-octahydro-1,4,5,8-diendomethanonaphthalene] proved about equally effective and more so than toxaphene. The median lethal dosages [*cf. loc. cit.*] were 0·04, 0·03 and 0·91 lb. active ingredient per acre, respectively.

In field tests against grasshopper nymphs, dusts were applied with rotary hand guns early in the morning, and sprays with a compressed-air sprayer giving complete coverage of the foliage later in the day at the rate of about 5 U.S. gals. per acre and a pressure of 40 lb. per sq. in. The insecticides acted as both contact and stomach poisons. Aldrin and dieldrin applied at 2 oz. per acre in sprays gave high mortality and were at least as effective as chlordan and toxaphene at about 1 lb. per acre, and aldrin and dieldrin applied in dusts at about 5 oz. per acre gave complete control and were better than toxaphene or chlordan at 1 lb., which gave comparable results in the two forms. Compound 1189 (an oxygenated dimer of hexachlorocyclopentadiene) was about as toxic as toxaphene or chlordan in dusts, but less so in sprays.

Munro (J. A.) & Post (R. L.). **Emergency Insect Control in North Dakota.**—*J. econ. Ent.* **44** no. 1 pp. 117–118, 1 ref. Menasha, Wis., 1951.

As a result of an outbreak of *Toxoptera graminum* (Rond.) on small grains in North Dakota in the spring of 1949, an organisation was set up at the State Experimental Station to deal with unpredictable outbreaks of pests and also with the evaluation of new insecticides. Investigations by this department showed that tetraethyl pyrophosphate and parathion gave effective control of *T. graminum*, that technical aldrin [1,2,3,4,10,10-hexachloro-1,4,4a,5,8,8a-hexahydro-1,4,5,8-diendomethanonaphthalene] at 4 oz. per acre controlled grasshoppers but not black field crickets [*Acheta* (*Gryllulus*) *assimilis* F.], and that heptachlor [1 (or 3a),4,5,6,7,8,8-heptachloro-3a,4,7,7a-tetrahydro-4,7-endomethanoindene] at 4 oz. and Compound 1189 [an oxygenated dimer of hexachlorocyclopentadiene] at 6 oz. per acre gave satisfactory cricket control, their residual effects persisting for up to three weeks. A mixture of 8 oz. chlordan and 1 lb. technical toxaphene per acre gave better control than either insecticide used alone at twice these rates.

The application of 24 fl. oz. 16 per cent. parathion emulsion concentrate per acre by aeroplane to maize heavily infested by the corn leaf Aphid [*Aphis maidis* Fitch] increased the yield from 40 to 48 bushels per acre. Toxaphene gave good control of the sugar-beet webworm [*Loxostege sticticalis* (L.)] at 2 lb. per acre early in the season and 2·5 lb. per acre later when the plants were large or the larvae were more than half grown.

Piquett (P. G.) & Bowen (C. V.). **Effect of abrasive Diluents on the Toxicity of Lindane to the American Cockroach.**—*J. econ. Ent.* **44** no. 1 pp. 118–119, 4 refs. Menasha, Wis., 1951.

In view of findings indicating that the increased toxicity of some insecticides when mixed with certain diluents is caused by more rapid penetration of the toxicant after abrasion of the surface of the insect by the diluent [*cf. R.A.E.*, A **33** 189 ; **36** 330], tests were made in which the toxicity of lindane [containing at least 99 per cent. γ benzene hexachloride] to *Periplaneta americana* (L.) was investigated when it was used alone as a surface film, as a dust mixed with 98 per cent. of an abrasive diluent (carborundum or quartz) and as a film

following exposure to the diluent. Male cockroaches with sealed mouth-parts were exposed in batches of 15 in dishes measuring 9 ins. in diameter, and ten replicates were made of each test. Exposure for 24 hours to 2·5 mg. of the mixed dust caused significantly more mortality than exposure for the same time to a film of 0·05 mg. lindane only, but exposure to the lindane film for 20 hours following exposure to 2·5 mg. diluent alone for four hours caused less mortality than exposure for 24 hours to the lindane film alone, the difference being significant when the diluent was quartz. It is thought that the higher toxicity of the mixed dust may be attributed to exposure to a larger surface of the toxicant due either to a finer division of the particles or to the coating of particles of diluent.

York (G. T.). **Oviposition by the Two-striped Grasshopper in a Strip-farming Area.**—*J. econ. Ent.* **44** no. 1 pp. 119–120, 4 refs. Menasha, Wis., 1951.

In 1948, it was found impossible to prevent economic damage by *Melanoplus bivittatus* (Say) in an outbreak area in north-eastern Montana by control measures applied along roadsides and field margins, and it was evident that many eggs must have been laid within the fields, since newly hatched nymphs were generally distributed through them. Observations at the beginning of the oviposition period of *M. bivittatus* in this area, in which alternate strips of crop and fallow, usually about 175 ft. wide, extend north and south across the fields, showed that the egg-pods were being concentrated in clumps of standing grain on the outside drill row next to the fallow, though some occurred in the fallow near the grain and in the grain strip. Further investigation of the outside 1 ft. of grain strip, the next 10 ft. into the grain, the rest of the grain strip to the centre, the first 11 ft. of fallow and the remainder of the fallow to the centre of the fallow strip showed that the number of egg-pods per sq. ft. was about ten times as great in the outside 1 ft. grain where it averaged 4·1, as in the adjacent grain zone, the central grain strip and the fallow adjacent to the grain ; few were laid towards the centre of the fallow. Although the concentration of egg-pods in the main portion of the grain strips was low, most of the pods in the field were in that portion ; only 10 per cent. of the total were in the edges of the grain strips, and over five times as many were laid in the grain strips as in the fallow. Miscellaneous sampling along roadsides and field margins indicated that the deposition of egg-pods there was comparable with that in the edges of the grain strips, but as the field margins were only 2–6 ft. wide, their contribution to the total population in fields that usually averaged 160 acres was considered negligible.

It is concluded that strip farming favours the grasshoppers, since each strip provides extensive lengths of margin, and the grasshoppers move out on the fallow for warmth during the day and back into the grain strips for protection or warmth at night. In strip-farmed areas in which *M. bivittatus* is present, sufficient sampling should be done in the edges of the strips, the main portion of the grain strip and the fallow adjacent to the grain to establish the ratios between the number of egg-pods in the different zones, after which the sampling of the grain margins only should provide a sufficient basis for estimating the number of pods present over a considerable area.

Arant (F. S.) & Jones (C. M.). **Influence of Lime and Nitrogenous Fertilizers on the Population of Greenbugs infesting Oats.**—*J. econ. Ent.* **44** no. 1 pp. 121–122, 2 refs. Menasha, Wis., 1951.

In 1948, greenhouse experiments were carried out in Alabama on the effects of lime and nitrogenous fertilisers on populations of *Toxoptera graminum*

(Rond.) on oats [*cf. R.A.E.*, A **35** 173]. Oats were grown in large pots containing unlimed Norfolk sandy soil (pH 5·65) or the same soil with the addition of ground limestone at the rate of 2 tons per acre. Phosphorus and potassium were added to all pots at the rates of 800 lb. superphosphate and 175 lb. potassium chloride per acre, and some were also treated with nitrogen at 40, 80 or 120 lb. per acre from sodium nitrate or ammonium sulphate, applied by three methods. The plants in one greenhouse were infested with a known number of Aphids and those in another kept uninfested as controls. The oats were sown on 31st January, infested on 16th March, examined on 31st March and 22nd April and harvested on 26th May.

The populations per leaf at the first count and per sq. in. leaf surface on selected leaves at the second were considerably smaller on plants that received nitrogen than on those that did not, and, in general, varied inversely with the amount of nitrogen applied, with no differences that could be attributed to the source or method of applying the nitrogen. The addition of lime usually also decreased the population, and the reduction due to it was greatest where no nitrogen was used. The average yield of grain per pot was reduced by the Aphid, but the extent of the reduction was difficult to correlate with the addition of lime or nitrogen because of the variable differences in yields.

Hibbs (E. T.) & Weaver (C. R.). **A Field Test of some organic Insecticides for Control of the Armyworm.**—*J. econ. Ent.* **44** no. 1 p. 122, 3 refs. Menasha, Wis., 1951.

A typical outbreak of *Leucania* (*Cirphis*) *unipuncta* (Haw.) in Ohio, in which scattered foci of intense infestation in wheat, maize and meadow grasses were not discovered until damage was extensive, occurred in June 1950. Under these conditions, arsenical baits are not always adequate, and organic insecticides were therefore tested.

In the first experiment, toxaphene, DDT and chlordan were applied to infested field maize at the rate of 1 lb. active ingredient in 37 U.S. gals. spray per acre between 2 and 4 p.m. on 23rd June, when the plants were 12–18 ins. high and in the whorl stage. Examination 60 hours later, during the night, showed the presence of 3, 5·3 and 13 living larvae per 200 plants, as compared with 26·3 for untreated plants. All treatments gave significant reductions, but chlordan was significantly inferior to the other two. In the second, parathion and lindane [at least 99 per cent. γ benzene hexachloride] were applied at 0·5 lb. toxicant per 100 U.S. gals. water, and toxaphene, DDT and chlordan at 1 lb. per 100 U.S. gals. to single-hill plots containing four plants of field maize 18 ins. high and in the whorl stage, and ten field-collected fully grown larvae were caged on or near them. Three days later, living and dead larvae were recovered from the cages and the damage to the maize was evaluated. As compared with no treatment, parathion, toxaphene and chlordan gave 96·4, 69 and 62·4 per cent. control of the larvae and DDT and lindane 51·3 and 5·1 per cent. Almost no feeding occurred on the plots treated with parathion ; toxaphene, DDT and chlordan were progressively less effective in preventing it, and feeding on the lindane plots equalled that on untreated ones.

Cutright (C. R.). **Comstock Mealybug in Ohio.**—*J. econ. Ent.* **44** no. 1 pp. 123–124. Menasha, Wis., 1951.

Comstock's mealybug [*Pseudococcus comstocki* (Kuw.)] has been present in Ohio for almost 30 years but was first found on apple in an orchard in the Ohio valley in 1939. Infestation was heavy, and about 80 per cent. of the fruits of one variety were partly or wholly covered with sooty mould growing

on the honeydew. Chemical and mechanical control measures proved unsuccessful in 1939–40, and biological control was therefore attempted in this and three neighbouring orchards, in which infestation was found in 1940–42, by the liberation of parasites reared at Charlottesville, Virginia [*cf.* *R.A.E.*, A **31** 464 ; **33** 208].

In 1940, *Clausenia* sp. and *Allotropa* sp. were liberated on 24th July and 8th August, respectively, and in 1941, adult females of *Pseudococcus* collected on 21st August showed a total parasitism of 3 per cent. by the two species. Liberations on 21st August 1941 of *Leptomastix* sp., *Pseudaphycus* sp. and *Clausenia purpurea* Ishii were followed by further releases of *Pseudaphycus* on 29th August and *Allotropa*, *Pseudaphycus* and *Clausenia* on 16th–17th September, and all were recovered in very small numbers from fully grown females collected in October 1941, when the total parasitism was 2 per cent. In 1942, parasites were released on 1st June and 24th July, and 2·9, 15 and 91·9 per cent. of the first, second and third generations of the mealybug were parasitised. *Allotropa* and *Pseudaphycus* were the only species recovered from the first and second generations and were dominant in the third from which a few *Clausenia* were also recovered. In this year, sooty mould was found on about 85 per cent. of all fruits, and an entomophagous fungus killed 8·9 and 17·4 per cent. of the unparasitised mealybugs of the second and third generations, respectively. In 1943, no parasites were liberated, and mealybugs were scarce, except in one orchard in which infestation was first noted in 1942 ; 11 per cent. were parasitised in late June and 95·7 per cent. in August. There was practically no fruit injury by sooty mould, except in the more heavily infested orchard, in which it was very great. In 1944–48, there was no commercial injury from mealybugs in any of the experimental orchards ; the percentages of parasitism recorded were 14·7 in 1944, 4·7 in 1945, 2 and 3·6 in the second and third generations of 1946, 13·6 and 64·5 in the second and third generations of 1947, and 1 in 1948. The entomophagous fungus was present each year and sometimes gave effective control. The use of DDT against the codling moth [*Cydia pomonella* (L.)] in 1946–48 also reduced the mealybug, but was very toxic to the parasites, particularly *Allotropa* and *Pseudaphycus* ; *Clausenia* seemed to be able to enter the sprayed orchards late in the season and parasitise the third generation.

In another orchard, about 15 miles away, in which *Pseudococcus* had been present for 3–4 years and had become injurious, parasites were liberated in May 1946 and were recovered from collections of the second and third generations, in which parasitism was 64·3 and 83·1 per cent. In 1947 and 1948, heavy schedules of DDT sprays practically eliminated both host and parasites.

BARKER (J. S.) & TAUBER (O. E.). **Development of Green Peach Aphid as affected by Nutrient Deficiencies in a Host, Nasturtium.**—*J. econ. Ent.* **44** no. 1 p. 125, 4 refs. Menasha, Wis., 1951.

In an attempt to record the effect of deficiencies of nitrogen, phosphorus, potassium, calcium or magnesium in nasturtium (*Tropaeolum majus*) on the development period of *Myzus persicae* (Sulz.) breeding on it, plants were grown in water cultures deficient in the different elements, and apterous females were confined on the leaves when the characteristic deficiency symptoms developed. They were allowed to deposit young for 4–5 hours, after which they were removed and a sample of 10–20 young was caged on another leaf. The process of selection was repeated for ten generations, and the number of days elapsing before the date of maturity was recorded as the development period. Control plants were grown in a full nutrient solution. Analysis of variance of the results showed no significant differences, and it is concluded that under these

experimental conditions the nutritional mineral changes to which the plants were subjected had no significant effect.

KLOSTERMEYER (E. C.). **Control of Mites on Alfalfa and Clover Seed Crops.**—*J. econ. Ent.* **44** no. 1 pp. 126–127. Menasha, Wis., 1951.

In recent years, mites of at least three species, identified by McGregor as *Tetranychus bimaculatus* Harvey, *T. atlanticus* McG. and *Septanychus* sp., have become troublesome on many field and vegetable crops in the irrigated areas of central Washington. The effects of infestation have been particularly serious on seed crops of lucerne, on which the mites were identified as *Septanychus* sp., and red clover, for enormous numbers develop and cover the plants and their flowers with webbing, thus preventing pollination by bees. Severely attacked plants become dry prematurely.

In 1950, a heavily infested lucerne seed crop that had been treated from an aeroplane with a dust containing 10 per cent. DDT and 70 per cent. sulphur at 20 lb. per acre against *Lygus* a fortnight before was dusted in the same way with a 1 per cent. TEPP (tetraethyl pyrophosphate). Neither treatment controlled the mites. On 6th July, therefore, dusts of 4 or 2 per cent. β-chloroethyl β-(p-tert.-butylphenoxy)-α-methylethyl sulphite (Aramite) or 2 per cent. ethyl p-nitrophenyl thionobenzenephosphonate (EPN) were applied to one-acre plots at the rate of 50 lb. per acre, and the rest of the field was dusted at the same rate with sulphur and bentonite (84 : 16). The whole field was dusted with 80 per cent. sulphur on 26th July. All dusts were applied by aeroplane. Population counts between 6th and 26th July and again on 24th August showed that populations were considerably less and the plants noticeably healthier after dusting with 4 per cent. Aramite than after any other treatment. Preliminary cage tests by H. F. Menke showed that this dust was relatively non-toxic to honey bees and *Nomia melanderi* Ckll., whereas EPN caused 100 per cent. mortality.

On red clover treated with a rotary hand duster on 17th August and examined for mites ten days later, 4 per cent. Aramite was significantly better than 2 per cent. EPN, 1 per cent. TEPP or no treatment.

RYCKMAN (R. E.). **Injurious Effects of *Paracantha culta* on Canadian Thistle in Wisconsin.**—*J. econ. Ent.* **44** no. 1 p. 127. Menasha, Wis., 1951.

In 1948–50, *Paracantha culta* (Wied.) was observed attacking the terminal flower buds of *Cirsium arvense* growing seven miles to the south-east of Shullsburg, Wisconsin. Practically all the plants on the plot were infested by the Trypetid, with the result that the tops died and flowering was delayed for about ten days, until the buds on lateral branches had developed. After the terminal buds were destroyed, the flies could not reproduce fast enough to attack the lateral shoots before they flowered, and by late summer they were unable effectively to prevent blossoming. Since some larvae were found dead, it is possible that natural enemies were attacking them. *P. culta* had previously been taken from several other species of *Cirsium* and in 13 other States.

ADAMS (J. A.). **Tests with Dieldrin for Control of Japanese Beetle Larvae in Turf.**—*J. econ. Ent.* **44** no. 1 pp. 127–128, 3 refs. Menasha, Wis., 1951.

In 1949, dieldrin [1,2,3,4,10,10-hexachloro-6,7-epoxy-1,4,4a,5,6,7,8,8a-octahydro-1,4,5,8-diendomethanonaphthalene] was tested against larvae of *Popillia japonica* Newm. in a low-lying field of long-established turf near Poughkeepsie, New York. The sod was shallow but tough, and the soil was

compact and poorly drained. When the insecticide was applied at the rate of 1 oz. per 1,000 sq. ft. (2·7 lb. per acre) in 10–20 lb. diluent with a fertiliser spreader in August, mortality of the larvae was gradual, leading to a reduction of about 90 per cent. by the following June. On plots similarly treated with 2 oz. dieldrin in November, the reduction was about the same by June, and control was complete on all plots by October 1950. The retardation in the control of the first generation may have been due to factors tending to delay contact between the toxicant and the larvae, such as lack of rain for a fortnight after application, exceptional resistance of the sod to penetration by the insecticide and the poor soil drainage.

FINNEY (G. L.), FLANDERS (S. E.) & SMITH (H. S.). **Mass Culture of *Macrocentrus ancylivorus* and its Host, the Potato Tuber Moth.**—*Hilgardia* **17** no. 13 pp. 437–483, 22 figs., 41 refs. Berkeley, Calif., 1947.

The authors describe the discovery of *Cydia* (*Grapholitha*) *molesta* (Busck) on peach in California and the development of methods of producing and liberating the parasite, *Macrocentrus ancylivorus* Rohw., for its control [*cf.* *R.A.E.*, A **34** 110, etc.). They outline the general process by which the parasite was reared in large numbers on larvae of *Gnorimoschema operculella* (Zell.) in potato tubers [*cf.* **32** 367, etc.] and give short accounts of the bionomics of the host and parasite. The method was improved by the development of a barrier for confining the host larvae [*cf.* **34** 345], which reduced the equipment needed and practically eliminated the problem of excess moisture [*cf.* **34** 305], and by the provision of cardboard floors covered with silt, preferably sand derived from crushed rock, in the units containing the host larvae, which caused them to pupate without wandering ; the cocoons were attached to the cardboard and convenient to handle. It was found that a temperature of 82°F. was suitable for the mass culture of *Macrocentrus* and its host and that the type of potato and of puncture affected the amount of infestation and parasitism [*cf.* **36** 18].

The buildings and equipment required for the mass culture of *Gnorimoschema* and its parasite, and methods of handling the potatoes, hosts and parasites are described in detail [*cf.* **33** 218 ; **34** 142 ; **35** 174], and factors affecting the sex ratio [*cf.* **35** 392], superparasitism and its effect on the cultures [*cf.* **34** 306 ; **35** 175], and methods of overcoming the difficulties of packing, transporting and colonising [*cf.* **33** 219 ; **34** 142] are discussed. Losses from insect, mite and disease attack [*cf.* **34** 314 ; **35** 129 ; **39** 256] can be prevented by the rapid use of material, fumigation of discarded potatoes with methyl bromide, cleaning the trays by immersion in boiling water, the use of healthy potatoes of suitable varieties, the prevention of high humidity and temperatures above 87°F. in the incubation and cocooning rooms, and immersing the eggs of *Gnorimoschema* in water heated to a temperature of 118–119°F. for 20 minutes [*cf.* **39** 257]. Notes on the cost of production and the practical results are included [*cf.* **34** 305].

Regulations for the Enforcement of the Federal Insecticide, Fungicide, and Rodenticide Act.—*S.R.A., P.M.A.* no. 166, 17 pp. [Washington, D.C.] U.S. Dep. Agric., 1951.

This publication contains the text of the U.S. Federal Insecticide, Fungicide and Rodenticide Act of 1947, with the Regulations of the Secretary of Agriculture and the Joint Regulations of the Secretary of Agriculture and the

Secretary of the Treasury for its enforcement. The Act is concerned with the packaging and marketing of economic poisons (materials for the control of insect and other pests) in the United States or its Territories and covers exports to foreign countries and imports from them.

SIMMONDS (F. J.). **Further Effects of the Defoliation of** *Cordia macrostachya* **(Jacq.) R. and S.**—*Canad. Ent.* **83** no. 1 pp. 24–27, 4 refs. Ottawa, 1951.

In connection with the attempt being made to control the weed, *Cordia macrostachya*, in Mauritius by the introduction of suitable phytophagous insects [*cf. R.A.E.*, A **36** 424, 425 ; **38** 190, 191] and the results of preliminary experiments on the effect of defoliation on the production of fruits by it [**36** 424], the effects of periodic heavy and light defoliation on the general growth of the plant were investigated. Three plants growing in metal containers were used, and all the leaves over 1 cm. in length on one of them and alternate leaves on another were removed at monthly intervals between April 1947 and January 1948, during which time 5,777 leaves, with wet and dry weights of 1,175·9 and 246·4 gm., were removed from the first and 1,552 leaves, with wet and dry weights of 985·9 and 232·4 gm., from the second. The diameters of the stems of these two plants and the untreated one at a height of 10 cm. increased by 0·2, 0·4 and 1 cm., respectively, the average increases in diameter of lateral branches exceeding 0·5 cm. in diameter were 0·2, 0·27 and 0·43 cm., and the lengths of stem bearing one whorl of leaves averaged 0·9, 3·4, and 8·1 cm. at the end of the test. After the first defoliation, the treated bushes produced more flowers than the untreated one, but they ceased flowering after the third month, whereas the control continued to produce inflorescences. It is concluded that if the introduced insects provide a similar degree of periodic defoliation, they should effectively check the growth and dispersal of *C. macrostachya* in Mauritius.

MALTAIS (J. B.). **The Nitrogen Content of different Varieties of Peas as a Factor affecting Infestations by** *Macrosiphum pisi* **(Kltb.) (Homoptera : Aphididae). A preliminary Report.**—*Canad. Ent.* **83** no. 2 pp. 29–33, 17 refs. Ottawa, 1951.

In view of the marked varietal differences known to occur among pea and lucerne plants in susceptibility to infestation by *Macrosiphum onobrychis* (Boy.) (*pisi* (Kalt.)) [*R.A.E.*, A **22** 294 ; **25** 780 ; **29** 202] and evidence that large quantities of nitrogenous food are necessary for the satisfactory development of Aphids, the nitrogen content of one susceptible and two resistant varieties of peas growing in replicated plots was investigated in Canada. The numbers of *M. onobrychis* on the terminal shoots of the susceptible and one of the resistant varieties, based on daily counts during nine years, averaged 209·6 and 67·9, respectively, and those on the other in three years ranged from 10 to 31·5. The nitrogen contents in plant samples and in water extracts were determined by methods described. The percentage contents of total nitrogen, water-soluble nitrogen and amino nitrogen at the first blossom and (in brackets) full-bloom stages were, respectively, 3·128 (3·329), 1·682 (2·629) and 0·555 (0·964) in the susceptible variety, 2·288 (2·988), 1·262 (2·103) and 0·4279 (0·7581) in the first resistant variety, and 2·661 (2·442), 1·367 (2·103) and 0·5186 (0·681) in the second one. The content of amino nitrogen appears to be the most important factor, since Aphids require soluble food, and most of the solutes in plants are amino acids and sugars [*cf.* **39** 154].

HALIBURTON (W.). **On the Habits of the Elm Bark Borer** *Physocnemum brevilineum* **(Say); (Coleoptera : Cerambycidae).**—*Canad. Ent.* **83** no. 2 pp. 36–38, 4 refs. Ottawa, 1951.

During studies on insects associated with Dutch elm diseases [*Ceratostomella ulmi*] in Quebec, several larvae and adults of *Physocnemum brevilineum* (Say) were found in the bark of living and recently dead American elms [*Ulmus americana*]. This Cerambycid, which is of little economic importance and apparently of no significance in the transmission of the disease, normally lives in the dry, outer bark of living elms, but observations showed that the larvae often injure the living inner bark, especially late in the season, by feeding along the surface of the phloem and may occasionally kill patches of cambium. If this occurs, patches of bark scale off, and the underlying wood becomes exposed to attack by other insects and develops defects. In felled logs, however, the larvae feed in the phloem as it dries out and then make galleries that lie half in the wood and half in the bark. Pupation takes place in a cell in the outer bark or, in logs, in the wood, and the total development probably lasts two years.

MESNIL (L. P.). **Remarques sur quelques Diaspines du pin sylvestre ou du génévrier et leurs parasites.**—*Rev. Path. vég.* **28** fasc. 2 pp. 73–97, 5 refs. Paris, 1949.

With a view to the introduction into Bermuda of parasites for the biological control of *Lepidosaphes newsteadi* (Šulc) on *Juniperus bermudiana* [*cf. R.A.E.*, A **39** 149], a study was made of this and certain other Coccids and their parasites in Europe. *L. newsteadi* has been recorded from various parts of northern and central Europe, always from places near rivers, and its preferred foodplant there is *Pinus sylvestris*. It was not observed by the author on any species of *Juniperus*, and the only locality in which it was common was in a section of the Rhône valley, in southern Switzerland, between Sierre and Susten, where the Simplon road runs to the south of the river. Most of the author's observations were made in that area, between the road and river. It was covered by *Pinus sylvestris* in a state of growth affected by poor soil and persistent drought, and its topography and climate are discussed in detail. It consisted of two ecological zones, the first, to the south, comprising a region of wooded dunes interspersed with ponds, in which the trees were about 15–18 ft. high and appreciably infested by *L. newsteadi*, and the second being the old river bed, which was completely covered by *P. sylvestris* growing to a height of only 6 ft. The trees in the river bed were heavily infested by *Leucaspis loewi* Colv. and various other insects, but *Lepidosaphes newsteadi* was scarce on them, except along a strip at the edge of the two zones, where it was extremely numerous, occurring together with large populations of *Leucaspis loewi* and other insects. The factors responsible for this distribution of *Lepidosaphes* are discussed. The Coccid was apparently prevented from advancing into the river bed by excessive humidity, and its large population at the edge of the infested zone is attributed to the weakening of the trees by the other insects present and differential parasitism due to the occurrence of *Leucaspis*.

Both Coccids were parasitised by *Prospaltella aurantii* (How.), *P. leucaspidis* Merc. and *Aphytis mytilaspidis* (LeB.), and *Leucaspis* also by *Aspidiotiphagus lounsburyi* (Berl. & Paoli) and *Azotus* sp. The only one of importance on *Lepidosaphes* was *P. aurantii*. Of the two Coccids, *Leucaspis* has the greater biotic potential, and if the population of *Leucaspis* on heavily infested trees was considerably greater than that of *Lepidosaphes*, the percentage parasitism of the latter was very low. On some trees, however, on which the populations

of the two Coccids were about equal, all examples of *Lepidosaphes* were parasitised. Parasitism of a given host increased with the density of its population. Thus, in the absence of *Leucaspis*, *P. aurantii* parasitised 8–10 per cent. of *Lepidosaphes* on trees on which the latter occurred at the rate of 1–2 per needle, whereas no parasites were reared from 100 examples of this Coccid collected at Plittersdorf, in the Rhineland, where infestation was very scattered.

Observations on the life-cycle of *L. newsteadi* showed that oviposition began on 15th March, reached its peak about the beginning of April, and usually continued until late April or May. A very few females oviposited as late as August, but most of them died in May and June. The crawlers hatched in a few days, migrated to needles of the preceding year, to which they attached themselves, and moulted. Development was slow during spring and summer, and the scale was only half-grown by August. The third instar was reached at the beginning of September, during which month development accelerated and the scale reached its maximum size. The males emerged in large numbers at the beginning of October, and pairing took place within a few days. The anatomy of the females is described in detail, together with various external changes observed during their development. Oviposition by *Leucaspis loewi* began at the end of April or the beginning of May and continued until July. The crawlers migrated and attached themselves to the needles of the new shoots. Their development was completely arrested during the warm season, and the scale was not formed until January and then only in the males, which thereafter developed very rapidly and emerged in April. The females did not resume development until March.

Detailed studies were made of the bionomics of the species of *Prospaltella*, chiefly *P. aurantii*, which are internal parasites of the two Coccids, and the rearing methods are described. The adults emerged from the remains of their hosts, and mass emergence was induced by exposure to light. They paired soon after emergence, and oviposition occurred 1–2 days later. The females searched continuously for hosts in which to oviposit, but frequently punctured the scales without depositing eggs. They attacked the two Coccids indifferently and in any stage. They usually oviposited in individuals that had not previously been parasitised but sometimes laid eggs in *Aphytis* and even in larvae of their own species. The egg, larval and pupal stages lasted 8–10, about 30 and 5–9 days, and the males and females lived for about 3 and 6 days, respectively ; adults of *P. leucaspidis* lived longer.

The annual cycle of *P. aurantii* was difficult to determine in the laboratory. Adults emerged in the field in early April, at the end of June and beginning of July, and at the end of August and beginning of September. Eggs laid in September generally gave rise to larvae that hibernated in the second instar and pupated at the end of the following March. Some, however, developed more rapidly and gave rise to adults at the end of the warm season, though not all of them emerged from their hosts. Those that did so oviposited in mature hosts. Parasitism of individuals of their own species and of *Azotus* sp., which is ectoparasitic on *Leucaspis*, was also observed at this time of year. The external and internal effects of parasitism by *P. aurantii* on *Lepidosaphes* are described in detail.

Observations on *Azotus* sp. showed that its life-cycle was similar to that of *P. aurantii*, but eggs laid in September gave rise to larvae that pupated by the beginning of October. In the laboratory, half these pupae gave rise to adults that paired and oviposited on the remaining pupae.

Subsidiary investigations were carried out on *Lepidosaphes juniperi* Ldgr. It was found at high altitudes on *Juniperus nana* in Corsica and on *J. sabina* and *J. communis* near the site of the observations at Sierre. The adult females overwinter and oviposit in late March, and its life-cycle is probably identical

with that of *L. newsteadi*; characters distinguishing the two species are given. A parasite that closely resembled *P. aurantii* was reared in small numbers from *L. juniperi*.

GRISON (P.) & VIEL (G.). **Action toxique et propriétés physiologiques de l'hexachlorocyclohexane.**—*Rev. Path. vég.* **28** fasc. 2 pp. 98–111, 29 refs. Paris, 1949.

The authors review literature showing that BHC (benzene hexachloride), especially the γ isomer, is able to produce either a stimulating or a depressing effect on the development of plants and micro-organisms according to the doses used and the species to which they are applied and describe laboratory tests on the effects of dusts and sprays of a technical BHC containing about 17 per cent. γ isomer on certain Lepidopterous larvae. The following is largely based on their summary of the results. When second- and third-instar larvae of *Thaumatopoea processionea* (L.), *Euproctis chrysorrhoea* (L.) (*phaeorrhoea* (Don.)) and *Operophtera brumata* (L.) were fed for four days on leaves dusted with 2 per cent. BHC, mortality was very low, and when last-instar larvae of *Aglais* (*Vanessa*) *urticae* (L.) were fed on leaves that had been sprayed with a suspension of 0·02 per cent. BHC prepared by adding an acetone solution to water, they were able to pupate normally after ingesting an amount equivalent to an average of 17·5 mg. BHC per kg. body weight daily. Larvae of *Lymantria dispar* L. that were fed from the beginning of the third instar on leaves treated with similar sprays containing 0·01, 0·025 and 0·05 per cent. BHC completed their development with little or no more mortality than occurred in the controls; the maximum amount of BHC ingested daily by any one larva during the last few days before pupation was equivalent to 45 mg. per kg. body weight. When larvae of *Bombyx* (*Sericaria*) *mori* (L.) were exposed to the same sprays on mulberry leaves from the beginning of the second or third instar, mortality was higher than in the controls, especially at the time of moulting and among larvae that had ceased to feed prior to pupation, and was complete for the highest concentration. The maximum amount of BHC ingested daily by any one larva during the last few days before it pupated was 31 mg. per kg. body weight. In a further test in which larvae of *B. mori* were fed from the time they hatched on leaves dusted with 0·1 per cent. BHC at 0·05–0·06 mg. per sq. cm., there was some mortality but the weight of the cocoons produced by the survivors and the fecundity of the females derived from them were unaffected.

BENNETT (S. H.), KEARNS (H. G. H.) & MARTIN (H[ubert]). **Investigations on Egg-killing Washes. III. The ovicidal Properties of certain organic Thiocyanates.**—*J. Pomol.* **23** no. 1–2 pp. 38–49, 10 refs. London, 1947.

The following is substantially the authors' summary of this paper, which is one of a series [*cf. R.A.E.*, A **24** 686; **25** 496]. Tests were made in the laboratory by a technique already recorded [**37** 51] of the ovicidal action of certain organic thiocyanates on the eggs of *Aphis pomi* Deg., *Psylla mali* (Schm.) *Operophtera brumata* (L.) and *Paratetranychus pilosus* (C. & F.) (*Oligonychus ulmi* auct.). Dodecyl thiocyanate, butyl carbitol thiocyanate and β,β′-dithiocyanodiethyl ether, in soap or sulphite-lye emulsions containing 0·4 per cent. thiocyanate, with or without 5 per cent. petroleum oil of winter-wash grade, were effective against eggs of *A. pomi*, but β-thiocyanoethyl laurate and the thiocyanates of secondary alcohols were ineffective at that concentration. In limited tests, dodecyl thiocyanate, at 0·4 per cent., with or without 5 per cent. petroleum oil, proved effective against the eggs of *Psylla mali* when applied in sulphite-lye emulsions; both butyl carbitol thiocyanate and β-thiocyanoethyl

laurate at 0·225 per cent. were ineffective when applied in 5 per cent. petroleum oil. Dodecyl thiocyanate (0·4 per cent.), butyl carbitol thiocyanate (0·4 per cent.), β-thiocyanoethyl laurate (0·225 per cent.) and β,β′-dithiocyanodiethyl ether (0·225 per cent.) were ineffective against the eggs of *O. brumata*, but did not reduce the ovicidal action of 5 per cent. petroleum oil emulsified with sulphite lye. Dodecyl thiocyanate at 0·4 per cent. was the only one of these materials to prove effective against the eggs of *Paratetranychus pilosus*, and it augmented the potency of 5 per cent. petroleum-oil emulsions. Neither white nor brown mustard flour at 1 per cent. was effective against eggs of the mite.

A high variability shown in the hatching of the eggs of *P. pilosus* and in their response to ovicides was found not to be associated with the age of the wood on which they were laid.

Austin (M. D.) & Massee (A. M.). **Investigations on the Control of the Fruit Tree Red Spider Mite (*Metatetranychus ulmi* Koch) during the Dormant Season.**—*J. Pomol.* **23** no. 3–4 pp. 227–252, 3 pls., 3 figs., 27 refs. London, 1947. (With an Appendix by S. C. Pearce, pp. 252–253, 6 refs.)

The following is based on the authors' summary. An account is given of a three-year investigation on the destruction of the winter eggs of *Paratetranychus pilosus* (C. & F.) (*Metatetranychus ulmi* auct.) on apple in south-eastern England by sprays of petroleum oil alone or petroleum oil containing 2·14 per cent. w/v DNC (dinitro-o-cresol) applied in January, February or March. The concentration of oil in all sprays was 5 per cent. v/v. Biological data relevant to the investigation are discussed. A procedure for recording the mite population is described. Measures designed to minimise risk due to spray-drift when treatments are applied to randomised blocks are outlined. It was shown that the sprays inhibit the hatching of high proportions of the winter eggs, that treatment in mid-February or March is significantly more effective than treatment in January, and that the inclusion of DNC has no significant effect. Even when the hatching of 97 per cent. of the winter eggs is inhibited by these sprays, the mites that hatch from the surviving eggs give rise to enormous populations by the late summer and consequently even out any broad differences previously ascribed to any given treatment. While the number of eggs of the first generation on sprayed trees can be correlated with the measure of winter egg destruction, this correlation cannot be made in late summer, when the build-up of mite populations has compensated for the initial check. This build-up occurs annually and is considerable, because there are three or more generations in the year. It is considered that a programme of winter and summer sprays will be necessary to achieve commercial control.

Dicker (G. H. L.). **Further Experiments on the Control of the Apple Blossom Weevil, *Anthonomus pomorum* L.**—*J. hort. Sci.* **25** no. 2 pp. 111–121, 2 refs. London, 1950.

The following is based on the author's summary. During the period 1946–48, dusting and spraying trials were carried out against *Anthonomus pomorum* (L.) on apple in southern England. In a test of dusts applied once, at the bud-burst stage, or twice, at bud-burst and six days later, one and two applications of 5 per cent. DDT reduced capped blossoms by 91 and 94 per cent., and one and two applications of 5 per cent. benzene hexachloride reduced them by only 18 and 66 per cent., respectively. Effective control was also obtained by spraying with 0·025 per cent. DDT at the bud-burst stage. From other experiments, it is concluded that good control will be obtained with 0·05 and

0·1 per cent. DDT in sprays of petroleum oil or dinitro-o-cresol and petroleum oil applied in March and February, respectively, and 0·1 per cent. DDT applied in a tar-oil spray during February.

The duration of toxicity of the various sprays is discussed, and it is shown that the persistence of the DDT deposit is increased when it is applied in oil.

POSNETTE (A. F.). **The Pollination of Cacao in the Gold Coast.**—*J. hort. Sci.* **25** no. 3 pp. 155–163, 2 pls., 17 refs. London, 1950.

The following is virtually the author's summary. The insects responsible for much of the cross-pollination of cacao have been identified as *Forcipomyia quasi-ingrami* Macfie and *Lasiohelea nana* Macfie in Trinidad [*cf.* *R.A.E.*, A **33** 78] and *Forcipomyia ingrami* Carter, *F. ashantii* Ingram & Macfie, and *Lasiohelea litoraurea* Ingram & Macfie, in the Gold Coast. The incidence of cross-pollination during 1946–48 at Tafo, Gold Coast, was found to vary between 18 and 43 per cent. by the use of a recessive character, "albinoism," to indicate self-pollinated progeny, and a dominant character, red pigmentation, to identify crossed progeny. The extent of cross-pollination was investigated and it was found that pollination occurred between trees two rows apart but less frequently than between adjacent trees. Double pollination by different pollen parents was shown to occur. A second application of pollen effected some fertilisation up to six hours after the first. The design of clonal plots planted for seed distribution is discussed in regard to pollination factors.

SHAW (H.) & STEER (W.). **Laboratory Studies on the Toxicity of Hydrocarbon Oils and similar Substances to the Eggs of some common Orchard Pests. I. General Introduction.**—*J. Pomol.* **23** no. 1–2 pp. 1–7, 12 refs. London, 1947. **II. Experiments on the Eggs of the Winter Moth** (*Operophtera brumata* **L.**).—*T.c.* pp. 8–22, 4 graphs, 11 refs.

SHAW (H.), STEER (W.) & DAVIES (R. G.). **III. Experiments on the Eggs of the Green Apple Aphis** (*Aphis pomi* **Deg.**).—*J. hort. Sci.* **25** no. 3 pp. 190–212, 2 graphs, 1 fldg. table, 14 refs. London, 1950.

These three parts belong to a series containing the results of laboratory investigations begun in England in 1934 on the factors involved in the action of hydrocarbon oils on the winter eggs of various orchard pests. In the first, which is introductory, the authors describe the 15 oils used. Apart from cotton-seed oil, which was included for comparison, they comprised tar distillates, two hydrogenation products of coal origin, commercial grades of anthracene oil, fuel oil, spindle oil and kerosene, and special fractions and extracts of oils. The first broad surveys of ovicidal properties were carried out on the whole oils and on the separated neutral, phenolic and basic components when phenols and bases were present in appreciable amounts. The neutral oils were further fractionated by distilling in cuts of 50 or 25°C., and some of the difficulties involved in this are discussed. The chief test organisms used were *Orgyia antiqua* (L.), *Operophtera brumata* (L.) and *Aphis pomi* Deg., while *Paratetranychus pilosus* (C. & F.) (*Oligonychus ulmi* auct.) and *Psylla mali* (Schm.) were used to a much smaller extent. The eggs were obtained by methods previously recorded [*cf.* *R.A.E.*, A **26** 297].

The other two parts deal with the tests on eggs of *O. brumata* and *A. pomi*, respectively, which were treated by dipping them in emulsions of the oils, and the following is based on the authors' summaries of the results.

A selection of tar and petroleum oils covering a very wide range of chemical types was tested against eggs of *O. brumata*, and the first broad survey showed

that of several physical and chemical characteristics determined for each oil, distillation range, especially the content of oil distilling above 300°C., was most closely related to toxicity, although it did not wholly explain it. Tests of distilled fractions of the neutral oils showed that toxicity increased with distillation range up to about 400°C. for any one oil, but varied widely between similar distillation ranges of different oils ; petroleum oils in general were much more toxic than the tar oils. Over the range of oils as a whole, though with some exceptions, it appeared that the proportion of aliphatic material in the oil, as judged by the percentage insoluble in dimethyl sulphate, might be a considerable factor in determining toxicity. Indirect evidence suggested that paraffinic components were probably more toxic than naphthenic. Viscosity seemed to have little connection with toxicity, and specific gravity appeared to affect it only within small, closely related groups of oils. The phenols and bases isolated from the tar oils were not sufficiently toxic to contribute materially to the toxicity of the whole oil nor present in sufficient quantity to reduce it by dilution.

Evidence is presented to show that toxicity to the eggs of *A. pomi* is determined mainly by the aromatic constituents of the oils, naphthenic and paraffinic fractions being of low toxicity. Toxicity cannot be correlated with any single property of the various oils, although distillation range and solubility in dimethyl sulphate jointly afford some guide to biological performance. This latter correlation, however, is far from complete, since aromatic fractions from different oil types, all distilling above 250°C., differ considerably in their toxicity. Tar phenols and bases separated from a low-temperature tar distillate are more toxic than is the remaining neutral oil, but there is some evidence of antagonism between the neutral oil and the phenols, bases or both. The susceptibility of the eggs to a horizontal-retort high-temperature tar distillate increases late in the season.

FRAPPA (C.). **Un parasite du cocotier dans la région nord-ouest de Madagascar.** —*Agron. trop.* **3** no. 5–6 pp. 274–281, 2 figs., 12 refs. Nogent-sur-Marne, 1948.

A survey in the north-west of Madagascar in September and October 1943 showed that coconut palms were being destroyed by *Melittomma insulare* Fairm. in the absence of control measures against it. In Madagascar, this Lymexylonid has been found only on coconut and is injurious only in the north-west [*cf. R.A.E.*, A **29** 341].

All stages are briefly described. The adults are found mainly at the beginning of the rainy season, between October and January. Males and females occur in approximately equal numbers, but the former are active nocturnal insects, attracted by light, and the latter sluggish in movement and more readily found in the plantations. They mate soon after leaving the galleries and live only about eight days, apparently without feeding. Examination of their ovaries indicated that the females can lay 200–300 eggs each. These are deposited in groups of several dozen, surrounded by a viscous secretion, in crevices or roughnesses on the roots near soil level or on the base of the trunk where there is little or no soil covering. The larvae hatch in about 12 days and bore into the bark and wood. As they grow, they tunnel inwards and upwards, and may reach a height of 24–32 inches above the ground, though the attacks are confined mainly to the base of the trunks. They continue to develop for several months, until the end of the cold season, and then burrow outwards to form a cell in which to pupate. The pupal stage lasts about a fortnight, and the newly emerged adults tunnel to the surface. There appears to be one generation in the year.

Usually, there are many larvae from a single egg-mass burrowing in an infested palm, and the resulting damage to the tissues at the base of the trunk provides conditions suitable for the development of various species of *Oryctes* or of termites, which soon extend it. In plantations that are well cared for, infested palms are scattered and only lightly attacked, and since they can readily replace the central roots destroyed by *Melittomma* with adventitious roots, do not show much reduction in general health. The palms should be carefully examined for infestation, which is revealed by the presence of reddish frass ejected by the burrowing larvae and by the dull sound of the rotten wood when the trunk is tapped, so that foci of infestation can be removed. In neglected plantations the injury is commonly much more severe. Palms that are not properly earthed up are susceptible to attack and cannot rapidly produce efficient adventitious roots, with the result that destruction continues until they are blown down. The symptoms of attack vary according to the nature and fertility of the soil.

Certain simple control measures [*cf.* **26** 433] have given excellent protection against *Melittomma* and are already employed to some extent in Madagascar, but the most important way of preventing serious damage is to improve cultural conditions and maintain the ground in good condition.

MALLAMAIRE (A.). **Acridiens migrateurs et acridiens sédentaires en Afrique occidentale.**—*Agron. trop.* **3** no. 11–12 pp. 630–634, 1 fig., 1 ref. Nogent-sur-Marne, 1948.

In this account of locusts and grasshoppers that occur in French West Africa, the author gives brief notes on the permanent breeding centres and habits of the three migratory locusts, *Locusta migratoria migratorioides* (R. & F.), *Schistocerca gregaria* (Forsk.), and *Nomadacris septemfasciata* (Serv.) and on the habits of the tree locust, *Anacridium moestum* var. *melanorhodon* (Wlk.), which sometimes forms swarms, followed by lists of a large number of non-migratory Acridids that are present on grassland from Senegal to Chad. Some of these become injurious when they attack young plantations of cereals. Young nymphs of *Oedaleus senegalensis* (Krauss) and *O. nigeriensis* Uv., which are often confused with those of *Locusta* or *Schistocerca*, have completely destroyed fields of millet [*Pennisetum typhoides*], sorghum and maize in Senegal and Niger, and young plantings of millet are sometimes seriously damaged by *Kraussaria angulifera* (Krauss) at the beginning of the rainy season, particularly in the French Sudan, and may also be attacked by other species. *Zonocerus variegatus* (L.) is widely distributed on many crop plants in many regions ; it was observed that along the banks of the Niger, where this species is abundant, the eggs can survive immersion for some time. Control of the migratory species is carried out by an official organisation, but dusts or emulsion sprays of benzene hexachloride can be used against the others and destroy the bands of nymphs in a few hours without damage to man, domestic animals or crops.

RISBEC (J.) & MALLAMAIRE (A.). **Les animaux prédateurs et les insectes parasites des riz cultivés en Afrique occidentale.**—*Agron. trop.* **4** no. 1–2 pp. 70–76, 9 refs. Nogent-sur-Marne, 1949.

In the entomological section of this paper, the authors record upwards of 50 species of insects that attack rice in French West Africa, either in the field or in store, with very brief notes on the habits and distribution of some of them.

Bouriquet (G.). **Les maladies cryptogamiques et les principaux ennemis végétaux et animaux du riz à Madagascar.**—*Agron. trop.* **4** no. 1–2 pp. 81–89, 9 figs., 25 refs. Nogent-sur-Marne, 1949.

This paper on pests and diseases of rice in Madagascar includes a section in which the author gives information on various insects and a mite. The growing crop is attacked by locusts [*cf. R.A.E.*, A **39** 29] and by the Pentatomid, *Diploxys fallax* Stål, which is fairly widespread and sometimes causes severe damage ; it can be controlled by clearing grass from embankments and the edges of canals, where it shelters after the rice harvest. The larvae and adults of the Hispids, *Trichispa sericea* (Guér.) and *Hispa gestroi* Chap., attack the leaves. *T. sericea* is sometimes very injurious. Sporadic outbreaks occur in October and November and are favoured by an extension of the dry season and by lack of sufficient irrigation water. The control measures recommended have already been noticed [**25** 602 ; **27** 665]. Sowing the rice under water has been reported to protect it from attack by these Hispids. The Dynastid, *Heteronychus plebeius* (Klug), causes important damage in rice-fields when they lack water [*cf.* **18** 103]. The adults emerge in February or March and are present until October, spending almost all their life underground. Mating takes place in the soil soon after emergence, and the females oviposit in fairly dry positions. Tillage exposes the larvae to desiccation and to destruction by birds. Minor damage is caused by the larvae of the Hesperiids, *Pelopidas* (*Pamphila*) *borbonica* (Boisd.) and *Parnara* (*Pamphila*) *poutieri* (Boisd.), and by the mite, *Tarsonemus oryzae* Targ. *Calandra* (*Sitophilus*) *oryzae* (L.) and sometimes also *Tribolium castaneum* (Hbst.) cause serious injury to the stored rice.

Meiffren (M.). **Swollen Shoot, maladie du cacaoyer.**—*Agron. trop.* **4** no. 11–12 pp. 563–578, 4 pls., 43 refs. Nogent-sur-Marne, 1949.

The author describes the distribution of swollen-shoot disease of cacao in the Ivory Coast, where it is less widespread and less injurious than in the Gold Coast [*cf. R.A.E.*, A **37** 173] and where two main strains of virus causing different types of leaf mosaic have been distinguished. These comprise a virulent one causing opaque lesions (Kongodia strain), which appears to be a variety of strain A, and one causing translucent lesions (Sankadiokro strain), which is similar to strain J and also occurs at Appropronou [*cf.* **37** 85]. The latter is more difficult to transmit and slower in action than the virulent strain, though it causes more spectacular symptoms at first. The Kongodia strain causes rapid die-back of the shoots and death in about two years, whereas the Sankadiokro strain results in gradual diminution of the yield. In a plantation affected by the latter, 7·3 per cent. of the trees were infected in December 1944 and 40·6 per cent. in 1948. Infection with the Sankadiokro strain does not protect the trees from infection with the Kongodia strain [*cf.* **37** 86].

Investigations on methods of transmitting infection and the importance of indigenous trees as sources of virus and of insects as vectors of different strains of it are discussed from the literature [*cf.* **37** 85–87], and a list is given of five of the mealybugs that have been shown to transmit the disease [*cf.* **39** 47, etc.]. Attempts in the Ivory Coast to transmit the Kongodia strain to and from five species of *Cola* gave negative results. In experiments in which mealybugs were transferred from infected to healthy cacao plants, the periods between infection and the appearance of symptoms on the latter were 40–59 and 60–63 days for the Kongodia strain transmitted by *Pseudococcus njalensis* Laing and *P. citri* (Risso), respectively, and 28–31 days for the Sankadiokro strain transmitted by *P. njalensis*.

Cacao trees attacked by the virulent strain in the Ivory Coast should be cut down as soon as possible, but there is doubt as to whether those attacked by the mild strain should be eliminated, with the resultant loss of practically normal harvests over a number of years, or allowed to remain, with the risk of spreading the disease. In a search for resistant varieties of cacao, uninfected trees have been isolated at Kongodia and Appropronou, by cutting down surrounding infected ones and planting bananas in their place, and subsequently infected by means of insect vectors. Of 311 trees so treated, 30 have developed the characteristic symptoms and been destroyed, and if the remainder show resistance or tolerance to the virus they will be increased by vegetative reproduction. It is possible that resistant or tolerant plants may be found among those introduced from other countries or that plants immunised by infection with a mild virus strain may be used. The use of a spray of white oil and a phosphorus compound, such as tetraethyl pyrophosphate, applied with a sprayer or atomiser for the combined control of mealybugs and Mirids, which cause severe damage, is being considered.

RISBEC (J.). **Les parasites des *Pseudococcus* du cacaoyer, vecteurs du Swollen Shoot en Côte d'Ivoire.**—*Agron. trop.* **4** no. 11–12 pp. 578–581. Nogent-sur-Marne, 1949.

Encyrtids reared from mealybugs on cacao in the Ivory Coast comprised *Leptomastix longipennis* Merc., which seemed to be the commonest, from *Ferrisia virgata* (Ckll.), *Pseudococcus citri* (Risso) and *P. njalensis* Laing; *Achrysopophagus aegyptiacus* Merc. from *P. citri* and *F. virgata*; ten females from *F. virgata* identified as *Anagyrus subproximus* (Silv.) though they differed from the original description in the colour of the antennae; and *Coccophoctonus abengouroui*, sp.n., which is described from females reared from *P. njalensis* at Abengourou and found (without host record) at M'Bambey in Senegal, the males being unknown. A species of *Thysanus*, possibly *T. elongatus* (Gir.), accompanied *Leptomastix longipennis* and was probably a parasite of it. *A. kivuensis* Comp. was reared from Coccids on other plants at M'Bambey.

Report of the Committee on the Protection of Building Timbers in South Africa against Termites, Wood-boring Beetles and Fungi.—$8\frac{3}{4} \times 5\frac{1}{2}$ ins., xiv+218 pp., 71 figs. Pretoria, S. Afr. Coun. sci. industr. Res., Nat. Build. Res. Inst., 1950.

In view of the widespread damage caused to building timbers in South Africa by termites and the scarcity of sheet metal for the construction of termite guards, which had in any case proved unsatisfactory there, a committee was set up by the South African Council for Scientific and Industrial Research in 1947 to investigate the problem and develop alternative protective measures. The work was later extended to include other insects and fungi that attack wood, and an account of the results is given in this progress report, which was produced with the aim of providing a basis on which a building code could be drawn up. The aspects dealt with include the bionomics of the various native termites that infest timbers in buildings in South Africa [*R.A.E.*, A **37** 265], the frequency and mode of infestation in two sample areas in the Transvaal, the efficacy of existing proofing practices in South Africa, work on the eradication of termite colonies on building sites and the prevention of infestation in buildings, the bionomics of the introduced termite, *Kalotermes* (*Cryptotermes*) *brevis* (Wlk.) [**38** 302], and beetles that attack seasoned or unseasoned timber in South Africa [**39** 146, etc.], the prevention of damage to timber by fungi, and research on the preservation of timber by impregnation

with chemicals [**39** 146, etc.]. The general recommendations of the Committee regarding policy for the control of timber pests and for further research are summarised in a final chapter. Regulations regarding the entry of timber from other countries and for controlling and preventing the spread of the introduced pests, *K. brevis* and *Hylotrupes bajulus* (L.), are reproduced in appendices.

HELY (P. C.) & LEVITT (E. C.). **White Wax Scale Control on *Citrus*. Demonstration Plots in Central Coast Orchards.**—*Agric. Gaz. N.S.W.* **61** pt. 6 pp. 307–310. Sydney, 1950.

Sprays of sodium carbonate used for the control of *Ceroplastes destructor* Newst. on *Citrus* in New South Wales [*R.A.E.*, A **22** 312 ; **30** 471] are not entirely satisfactory because they are not fully effective if applied before the young scales have begun to cause damage, are affected by rain, cause varying amounts of leaf-fall and fruit-injury, and are incompatible with bordeaux mixture. Sprays of white oil, which can be used with bordeaux mixture, have given very good control under many conditions when applied while most of the crawlers are feeding on the mid-ribs of the leaves prior to settling on the twigs, but poor results have been reported by some growers, who attribute them to irregular hatching. Further investigations on their value were accordingly carried out on Valencia and mandarin oranges in orchards in two areas.

Observations on 19th and 20th October indicated that most of the Coccids were gravid ; the average percentages that contained eggs varied from 84·5 on the northern side of the trees to 52 on the southern. Some of the trees were sprayed with white oil (1 : 40), alone or in bordeaux mixture, on 15th or 16th December, when hatching was well advanced and migration to the stems had not begun, and others with a spray of 12 lb. anhydrous sodium carbonate and 1 gal. white oil per 100 gals. water on 10th or 11th February, when they were heavily infested by the Coccid, covered with sooty mould and retarded in growth of new shoots, whereas the oil-sprayed trees at that time were almost free from infestation and had made good growth. Counts in April showed that the numbers of living Coccids per twig on the trees sprayed with oil (1 : 40) and soda, respectively, were 1·3–2·4 and 0·4–1·05 on mandarins, and 3·4 and 9·9 on Valencias. The leaves of Valencias are erect and difficult to cover adequately, and the soda spray on them may have been affected by rain, which fell shortly after its application.

White oil was also tested in schedules involving two applications, at the middle and end of December, with the concentration in the second or both reduced to 1 : 80, but the degree of control was about the same as that obtained with the single application. It was satisfactory in all districts, though mortality was low on a few trees close to an area in which the dust deposit was heavy. The poor control reported by growers is attributed to defective spraying. This should be performed very thoroughly, and tower equipment is necessary for the tops of large trees, where control is often unsatisfactory. If early white-oil sprays do not give complete protection, spot applications of soda sprays can be made later.

KALSHOVEN (L. G. E.). **De plagen van de cultuurgewassen in Indonesië. Deel II.** [The Pests of Cultivated Plants in Indonesia. Part II.]—$9\frac{1}{2} \times 6\frac{3}{4}$ ins., pp. 513–1065, 8 col. pls., 281 figs., many refs. The Hague, W. van Hoeve, 1951. Price 39.50 *gld.*

This second and concluding volume of a work on crop pests in Indonesia [*R.A.E.*, A **38** 265] contains, in addition to the sections on birds, mammals,

and amphibia and reptiles, the rest of the Lepidoptera, and the Coleoptera, Diptera and Hymenoptera. Many species of these last three orders are parasitic or predacious on injurious insects, and the information given on these usually includes their hosts and any use that has been made of them for biological control, in addition to their morphology, habits and distribution. Injurious species are noticed in the same way as in the first volume. The work concludes with a systematic list of plants, showing the pests responsible for various sorts of injury to them.

Wagn (O.). **Coloradobillen** (*Leptinotarsa decemlineata*) **i Danmark. Biologiske iagttagelser 1950.** [The Colorado Beetle (*L. decemlineata*) in Denmark. Biological Observations in 1950.]—*Månedsovers. PlSygd.* no. 315 pp. 118–121. Copenhagen, 1950. (With a Summary in English.)

Observations on the bionomics of *Leptinotarsa decemlineata* (Say) on potato in Denmark were carried out in the laboratory and in an insectary in 1950 and indicated that it would have only one generation a year in that country [*cf. R.A.E.*, A **39** 130]. Adults that had been collected in 1949 and had overwintered in the soil emerged between 22nd April and 10th June and paired and oviposited after feeding on the leaves. The egg stage lasted 9–10 days in the hottest season and longer later in the year. The first eggs were observed on 6th June and the first larva to enter the soil to pupate did so on 13th July. The larvae pupated a week after entering the soil, and the pupal stage lasted about a fortnight. Adults emerged on 29th July in the laboratory and 4th August in the insectary, but mass emergence did not occur until the end of August. The adults paired, but entered the soil for hibernation without ovipositing.

In tests of alternative food-plants, the larvae fed readily on *Datura stramonium* but refused *Nicotiana rustica*. Development was completed on young tomato plants, lasting 42 days from egg to adult, but older tomato plants appeared to be unattractive to the adults.

Thomsen (M.), Buchwald (N. F.) & Hauberg (P. A.). **Angreb af** *Cryptococcus fagi, Nectria galligena* **og andre parasiter paa Bøg i Danmark 1939–43.** [Attack of *C. fagi, N. galligena* and other Parasites on Beech in Denmark in 1939–43.]—*Forstl. Forsøgsv. Danm.* **18** no. 2–3 pp.[2+] 97–326, 43 pls. (1 col.), 8 figs., 4 pp. refs. Copenhagen, 1949. (With a Summary in English.)

The following is based on the authors' summary of this detailed account of work carried out in Denmark in 1939–43 on an unusually severe outbreak of *Cryptococcus fagi* (Baer.) on beech that had occurred just previously. Forests in Seeland, especially those to the north of Copenhagen, were the most severely affected ; trees from 20 to over 100 years old were attacked, and many of them were killed. The outbreak was largely over by the time the investigations began, but one experimental plot still showed secondary injury and was studied in detail.

It was found that *C. fagi* was the primary pest concerned in the attack. The Coccids occurred in belts or patches on the trunks, near the ground on young trees, but higher up on older ones. Lightly infested trees recovered with a reduction in infestation, but large populations of the Coccid led to serious injury to the bark and attack by secondary pests. The first of these were various saprophytic organisms that developed on the dead and dying tissues ; they gave rise to a yellowish liquid that loosened the bark from the wood and dripped down the tree, killing further areas of bark. Areas injured

by the Coccid or this liquid were later attacked by a species of *Nectria* that proved to be not *N. coccinea*, as was expected [*cf. R.A.E.*, A **22** 497 ; **38** 195], but *N. galligena*. This further weakened the trees, and sometimes even killed them, but in any case rendered them suitable for attack by the Scolytid, *Trypodendron* (*Xyloterus*) *domesticum* (L.), which makes galleries on the surface of the wood beneath the bark, and the Lymexylonid, *Hylecoetus dermestoides* (L.), which bores radially into the wood, sometimes reaching the centre of the tree. The damage was continued by a succession of wood-destroying fungi.

The world distribution of *C. fagi* is shown on maps and discussed, and its stages are described. Males are unknown. Development lasted a year, the adults occurring from late May or early June and ovipositing until September or October. The eggs hatched in autumn and hibernation took place in the first instar on the bark. The Coccids were attacked by various predators, notes on which are given, but none was common. *T. domesticum* also had one generation a year, the young adults overwintering in the galleries in which they had emerged, but development of *H. dermestoides* was more protracted, and field evidence indicated that it required two years and possibly three. The adults of *Trypodendron*, the adults, larvae and pupae of *Hylecoetus* and the galleries made by both of them are described.

The causes of the outbreak of *C. fagi* were obscure, but may have included a series of warm summers in 1930–39 and a general lowering of the water table owing to increased supplies to towns. Its collapse was apparently due to the cold winters of 1939–42.

Papers noticed by Title only.

Muesebeck (C. F. W.), Krombein (K. V.), Townes (H. K.) & others. **Hymenoptera of America north of Mexico : synoptic Catalog** [including three new genera, two new subgenera, many other new names, and new synonymy]. —*Agric. Monogr. U.S. Dep. Agric.* no. 2, 9¼×6 ins., [1+] 1420 pp., 1 fldg. map. Washington [D.C.], 1951. Price $4.

Balachowsky (A.). **Les cochenilles de France, d'Europe, du Nord de l'Afrique et du bassin Méditerranéen. III. Caractères généraux des cochenilles. Reproduction—Développement embryonnaire. Développement post-embryonnaire.**—*Actual. sci. industr.* [no.] 784, 114 pp., 5 pls., 22 figs., 8 pp. refs. Paris, 1939. **IV. Monographie des Coccoïdea. Classification—Diaspidinae (Première partie).**—*T. c.* [no.] 1054, 154 pp., 32 figs. 1948. **V. Diaspidinae (Deuxième partie). Aspidiotini.**—*T. c.* [no.] 1087, 163 pp., 41 figs. 1950. **VI. Diaspidinae (Troisième partie). Aspidiotini (fin).**—*T. c.* [no.] 1127, 162 pp., 4 pls., 36 figs., 13½ pp. refs. 1951. [*Cf. R.A.E.*, A **26** 696.]

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